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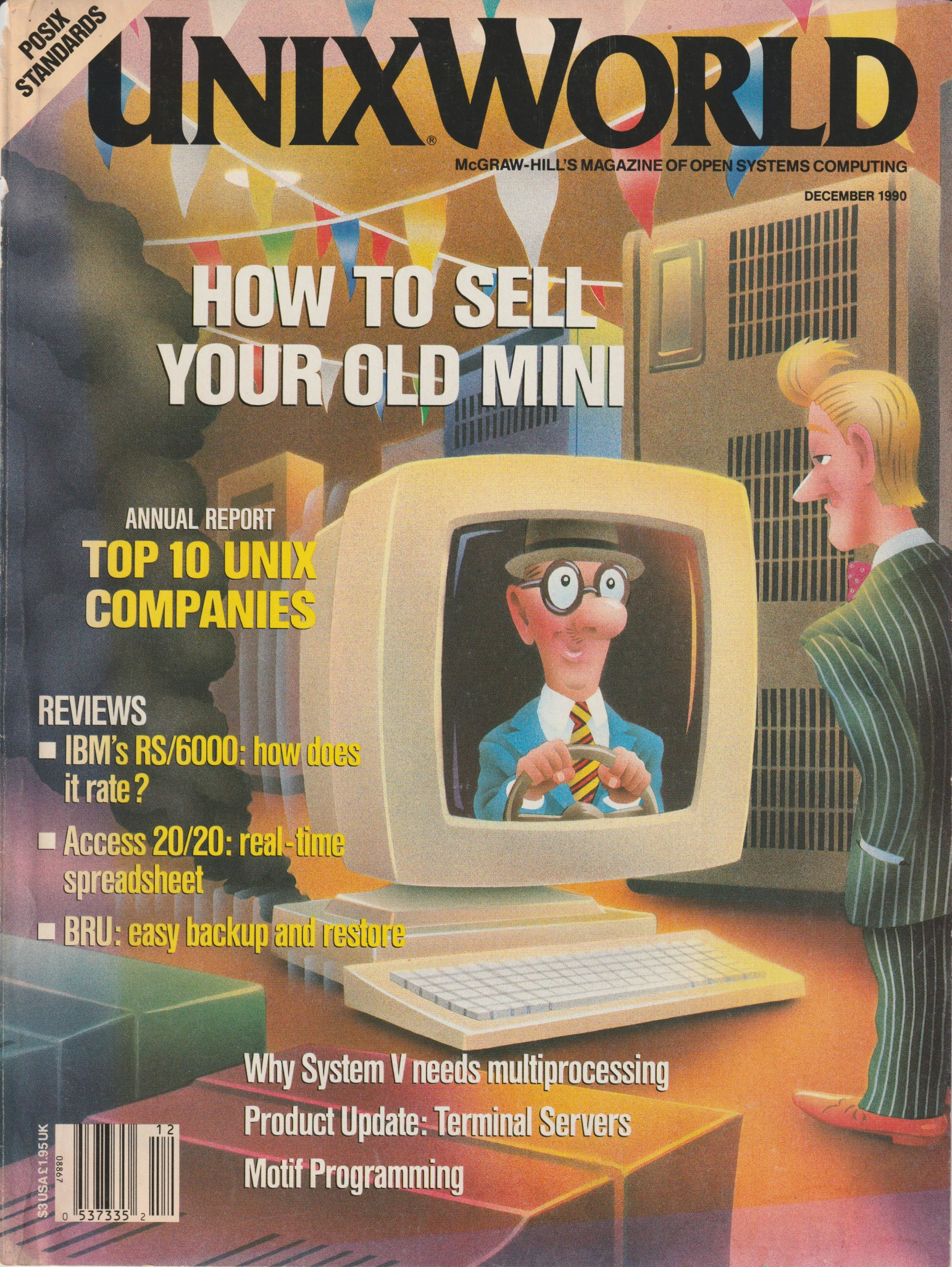
UNIX WORLD®

McGRAW-HILL'S MAGAZINE OF OPEN SYSTEMS COMPUTING

DECEMBER 1990

HOW TO SELL YOUR OLD MINI



ANNUAL REPORT

TOP 10 UNIX COMPANIES

REVIEWS

- IBM's RS/6000: how does it rate?
- Access 20/20: real-time spreadsheet
- BRU: easy backup and restore

Why System V needs multiprocessing

Product Update: Terminal Servers

Motif Programming

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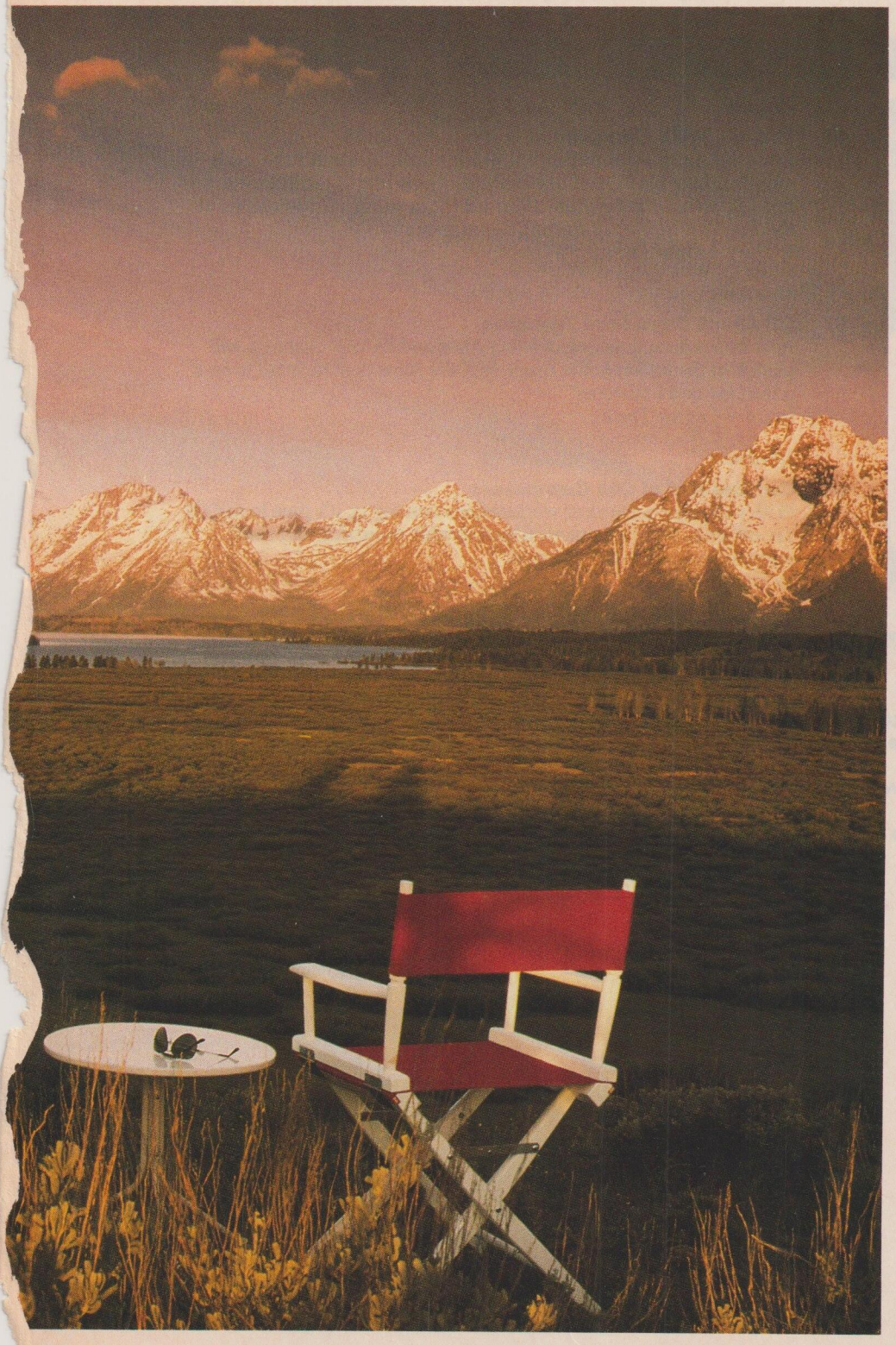

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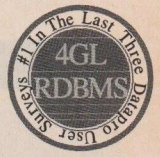

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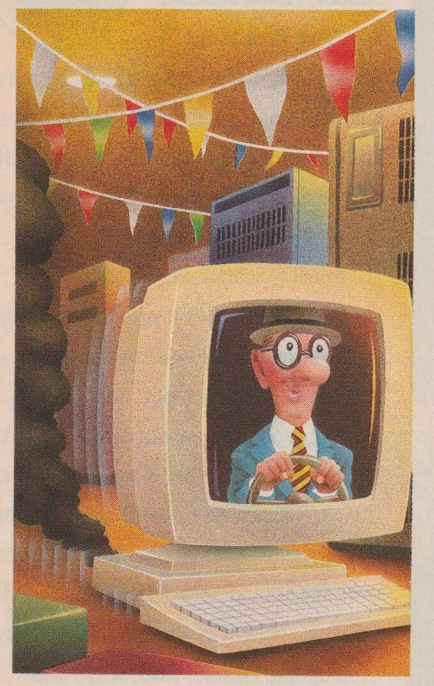
COVER STORY



Writer Frank Hayes found that getting rid of your old mini is like selling your old car–only worse. You're going to need some aggressive strategies, and we've got a practical story full of useful information on whom to call and what to expect. See page 64. (Cover illustration by Robert Grossman.)

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Once again it's our annual list of which companies make the most money selling UNIX, and our analysis of how they do it. This year we find that despite glum predictions for the economy, the revenues of the Top 10 UNIX vendors continue to grow.
by Gary Andrew Poole

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Acer hopes its acquisition of ailing Altos and its VAR channels will push it to the billion-dollar mark. Will the Altos deal turn out to be a milestone or a millstone?
by Gary Andrew Poole

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by Frank Hayes

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A major buzz phrase of the 1990s–distributing computing–is the topic of many conference discussions. Let's leave the theory and get to reality. Can you spread your computing workload across a network?
by Frank Hayes

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New products called terminal servers can give you access to different hosts and decrease connectivity costs.
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The first major product to run under Sun's Open Windows, Access 20/20 has real-time processing capabilities.
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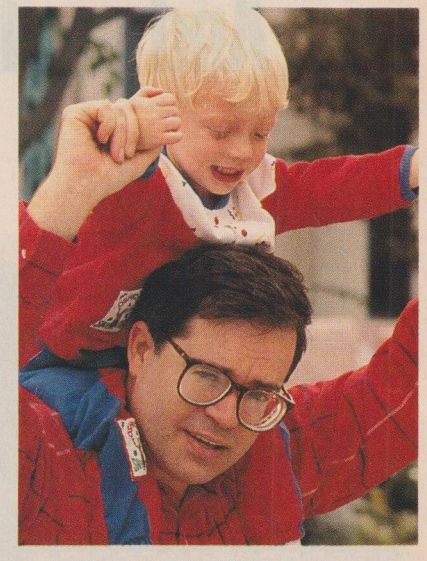
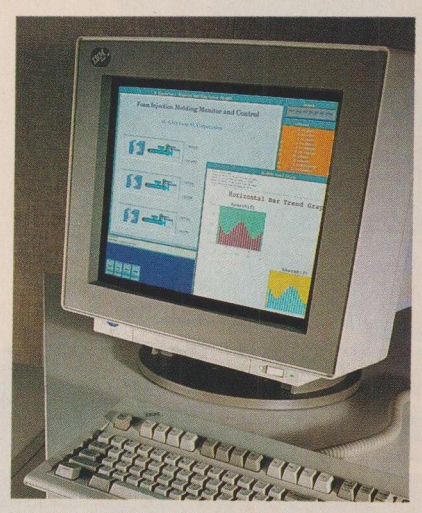


Top: *When George White started Corollary in 1985, he envisioned the multiprocessing power of a minicomputer on a PC. Five years later, many PC vendors are following his lead. To find out what it took to get his company off the ground, see page 39.* **Below:** *Our first review of IBM's RS/6000. We found fast workstation performance, but sluggish multiuser capabilities. See page 88 for our benchmarking results.*



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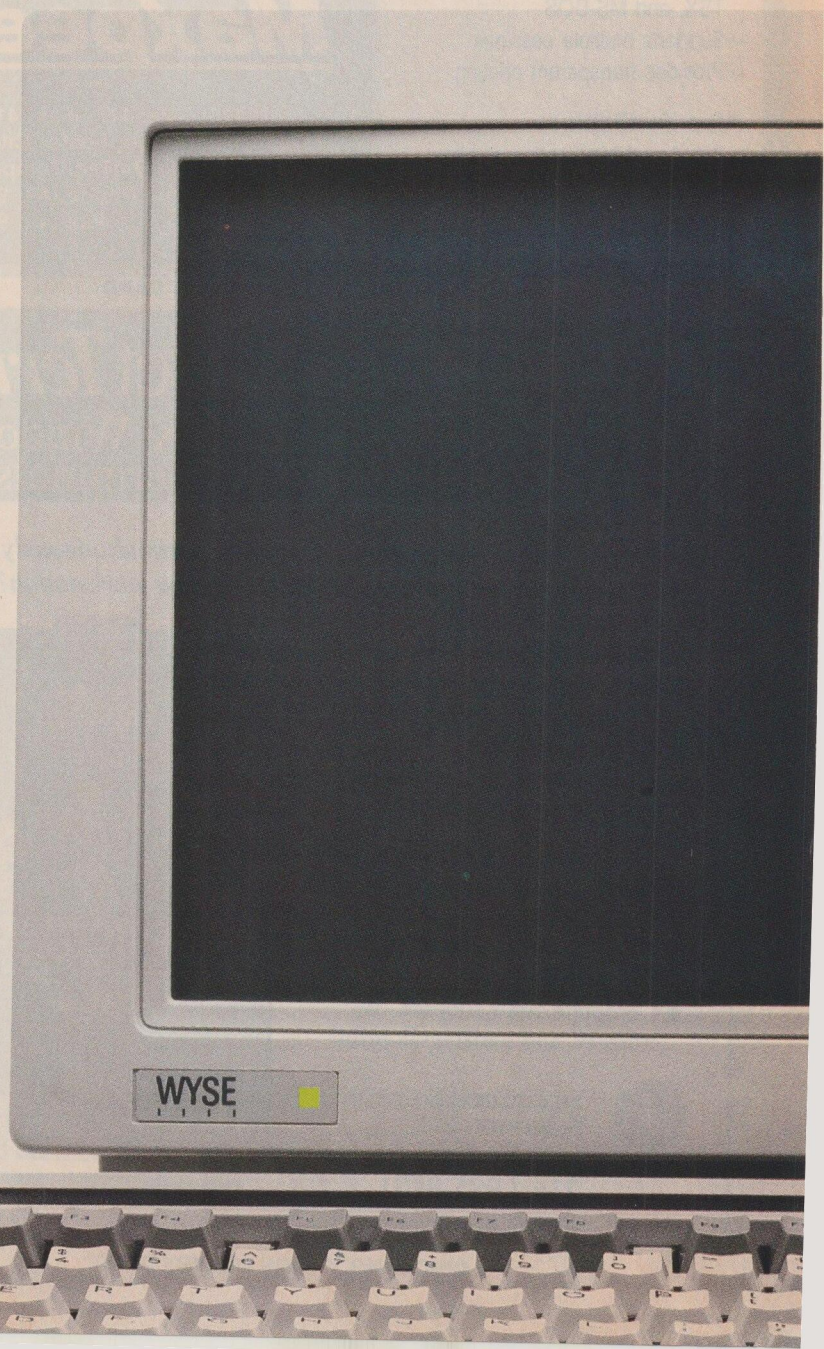

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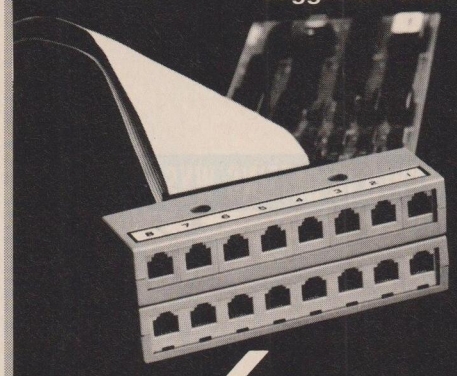

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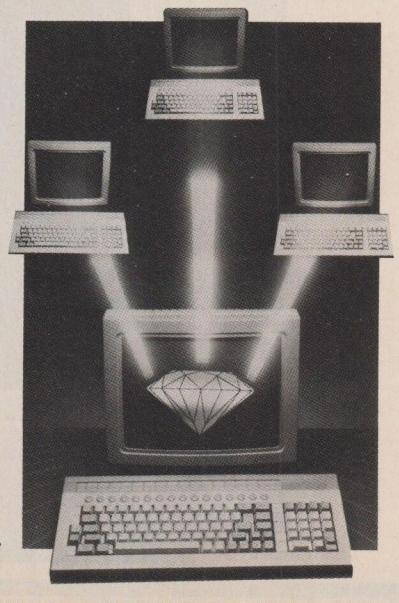

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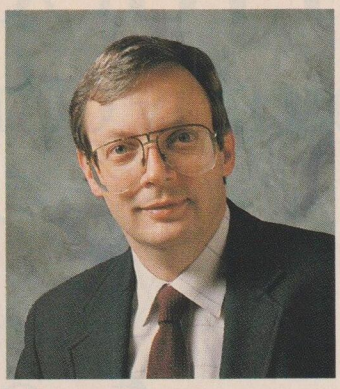

DOWN THE OPEN ROAD TO INTEROPERABILITY

Creating interoperability–getting computers made by a variety of manufacturers to share data as well as the work to be done on the data–is a mind-boggling undertaking. Interoperability is easily the major challenge facing corporate data processing managers in the 1990s.

Nina Lytton's Executive Interop, part of the Interop '90 trade show held in October in San Jose, did a great job of covering the issues and proposing routes to interoperability for users and vendors alike. One realist at the conference pointed out that getting computers to work together is really no more difficult than getting people to work together. And he added, "We all know how easy this is by looking at the state of the world today."

If we could standardize all the various formats for data, we would still have a long way to go before we could agree on how to share the work on this data among computers from different vendors. Even IBM has not been able to solve this dilemma, and it has total control (theoretically) of its disparate computer systems. The means of distributing applications on computers from many vendors eludes us, even as we try to plan a future based on it.

Typical of the interoperability problems DP/MIS people face is the inability to communicate with databases from different vendors. Even when these databases should be able to communicate because they all speak the same language, SQL, they can't communicate because their vendor-specific versions of SQL have been made deliberately inconsistent. There are hundreds, maybe thousands, of places where the lack of a standard language or an agreed-upon procedure or protocol prevents computers and applications from working together in harmony and cooperation.

We know how we got into this mess. It's mainly because vendors have "added value" to their products and have thus added incompatibility with other vendors' products. But vendors' profit motives are not the only culprit preventing interoperability.

Only 20 percent of personal computers are networked. This is not due just to a lack of technology or even the means to employ it. Often personal computer users do not value communication, cooperation, and shared resources. The irony is that personal computer enthusiasts had to overcome similar closed-mindedness on the part of data processing management to bring their computers to work in the first place. People, as much as their machines, are obstacles to interoperability.

The benefits of open systems are many. They are not widely understood by computer users who continue to rely on systems from one or two vendors. Granted, these benefits are not all here today, but eventually they will include the ability to share data and applications that reside on computers and databases from many vendors. In the bargain we will get lower hardware, software, support, and training costs as well.

We can take advantage of open systems because they are created in a free and open marketplace. This allows competition to reduce costs, improve quality, and meet the needs of our information age. However, this free and open competition has a necessary and powerful limitation: Innovation in implementation must comply with interface standards if the whole is to be greater than the sum of its parts.

More and more computer buyers are expressing their desire to create this whole from the sum of their computer investment. Nina Lytton's advice for buyers:

- Be an aware, informed buyer.
- Know your own priorities.
- Focus on information flow.
- Specify standards, not products, and insist on ongoing compliance.
- Buy as open a system as possible, but buy now what makes sense now.
- When you develop applications, manage for portability and avoid proprietary features unless it is technically essential.
- Participate in defining functional requirements for needed standards.

How fast we move to computer interoperability has little to do with the acceptance of the UNIX operating system on mainframes, servers, or even the desktop. It will have everything to do with how well data processing managers and personal computer users understand our critical need for interoperability among these systems.

For this to happen there was another critical bit of advice about openness from Nina's forum. Keep an open mind.

Dave Fiedler

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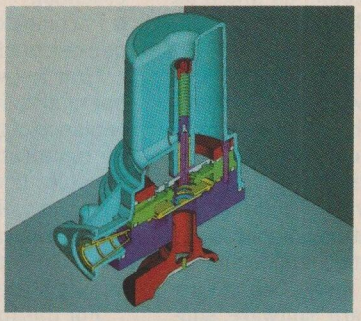
Whatever you're creating, you'll sail into a whole new age with any of the four POWERstations in the RISC System/6000 family. Because POWER (Performance Optimization With Enhanced RISC) processing can give you performance you've probably only dreamed about:



up to four instructions per machine cycle, 42 MIPS and 13 MFLOPS. Suddenly, complex designs don't take eons anymore.

The four RISC System/6000 POWERstations feature a range of graphics processors from grayscale to Supergraphics to satisfy any graphics demand. Great news for Power Seekers working on animation, scientific visualization, medical imaging and engineering solutions like CADAM,™ CAEDS™ and CATIA.™ And for electrical design automation, there's IBM's all new CBDS™ and an arsenal of over 60 EDA appli-

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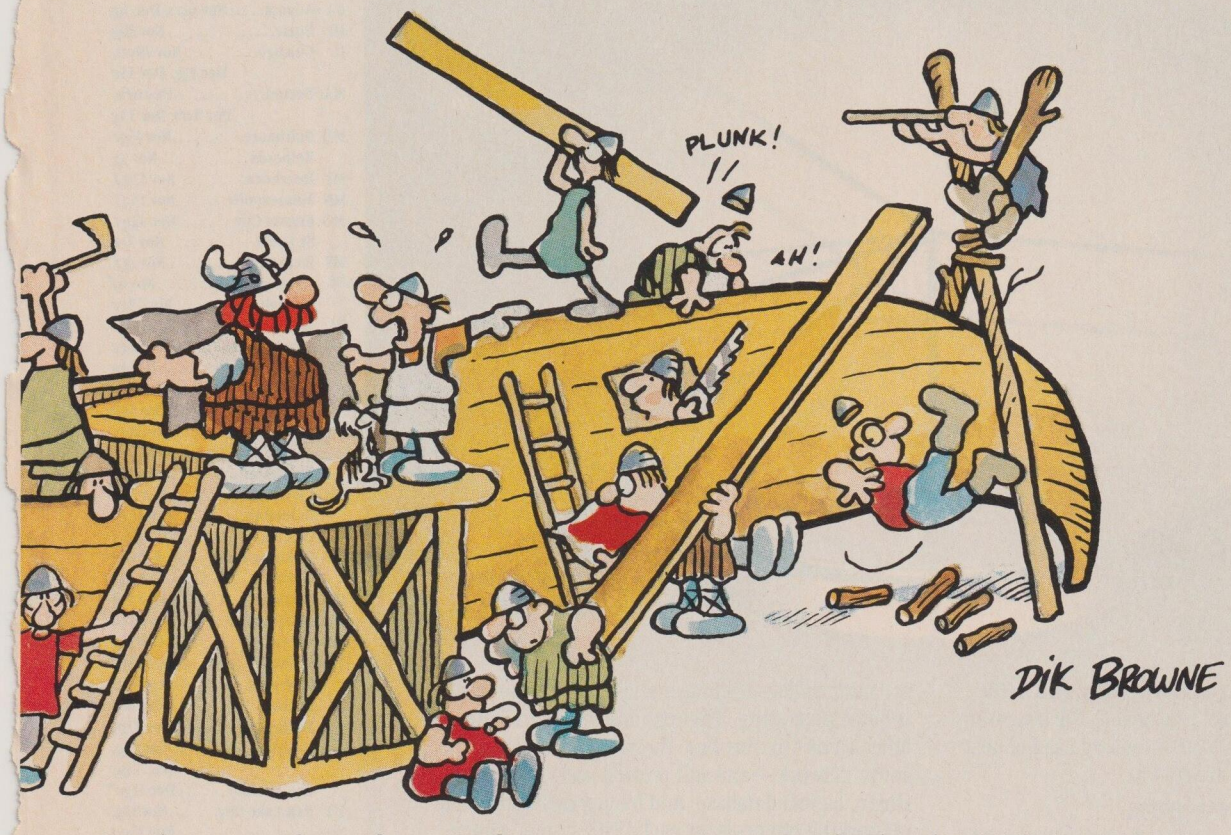
6000™ family.
will seem downright primitive.



cations from more than a dozen vendors.

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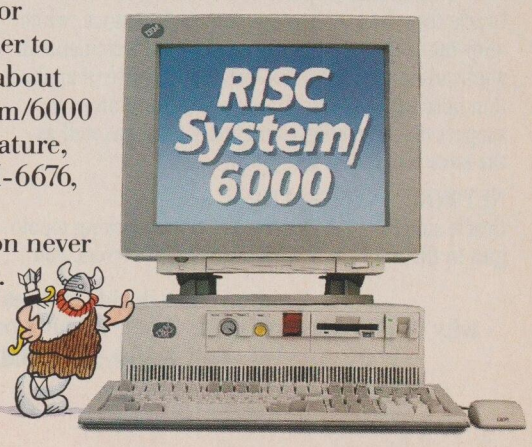
So if you're tired of paddling upstream with yesterday's performance, call your IBM marketing representative or Business Partner to find out more about the RISC System/6000 family. For literature, call 1 800 IBM-6676, ext. 991.

Civilization never looked so good.



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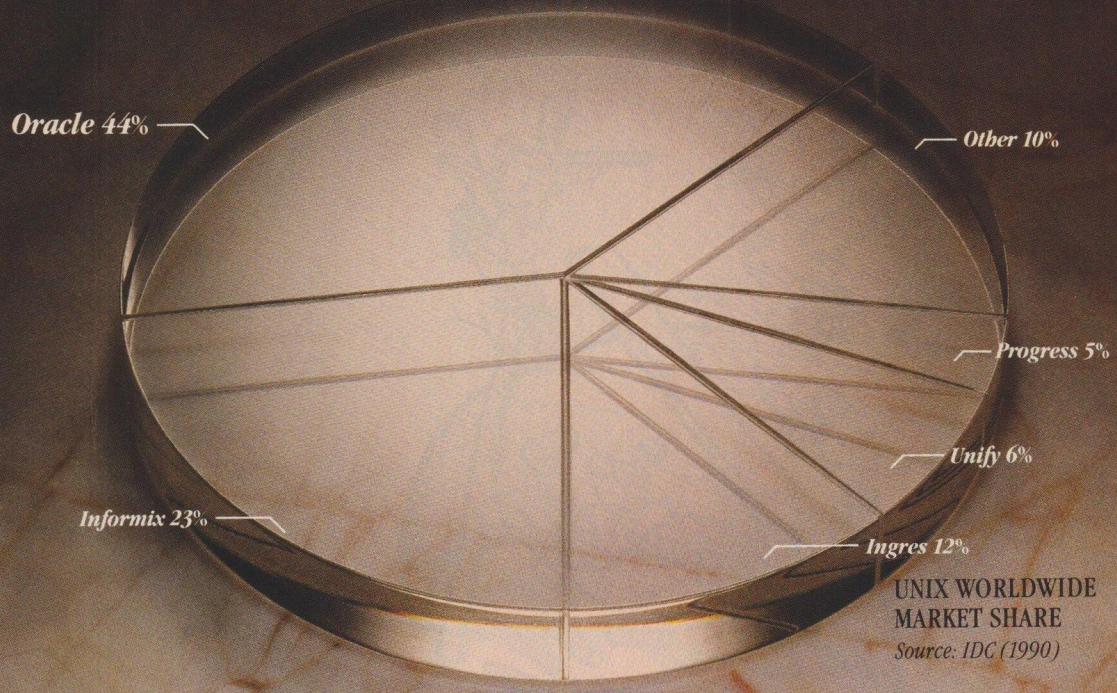

UNIX WORLDWIDE MARKET SHARE
Source: IDC (1990)

There's a lot of talk about who is number one in the UNIX marketplace. The fact is, Oracle is the largest supplier of UNIX database software — as large as the next three vendors combined. Here's why.

TECHNOLOGICAL INNOVATION.

Oracle supports new technologies first. Sophisticated RISC architectures. Powerful symmetrical multiprocessors. Even massively parallel processing machines. Oracle translates technology into performance, while allowing you to maintain your current investments in applications and data. And Oracle's promise of application portability means that you can count on us to support the technology you choose today, as well as the ones you choose tomorrow.

NETWORK INTEGRATION.

Oracle supports the widest range of networking topologies in the industry. With Oracle's UNIX servers, you can connect PC, Macintosh and UNIX clients for distributed processing. They can also communicate with other servers to distribute the database over your entire network — and still provide users access to a single, logical database. And by supporting multiple networking protocols for each UNIX system, Oracle gives you a highly flexible solution for your particular network configurations.

OPEN SOLUTIONS.

UNIX users demand open systems. Oracle has addressed those needs by supporting seamless interfaces between our products and those of other vendors, such as IBM DB2 and VAX RMS. Oracle's unique open architecture also supports interfaces with products like SAS, WordPerfect, Lotus and Uniplex. And Oracle incorporates all major industry and de facto standards to ensure applications interoperability.

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AL	Huntsville	Nov 8*gs**
AZ	Phoenix	Dec 6*gi*
CA	Los Angeles	Nov 15*g*, Dec 11*gc*
	Manhattan Beach	Dec 13*c/s*
	Newport Beach	Nov 8*cg*, Dec 5*g*
	San Diego	Dec 4*g*
	San Francisco	Nov 12*gu*, Nov 13*f*, Dec 11*c/s*, Dec 18*gc*
	Santa Barbara	Nov 14*gf*
	Santa Clara	Nov 14*gf*, Dec 19*gf*
CO	Denver	Dec 6*gc*
DC	Washington	Nov 20*gu**, Dec 13*gc**
FL	Ft. Lauderdale	Nov 15*gf*
	Kissimee	Nov 6*g**
	Miami	Nov 2*c/s*
GA	Atlanta	Nov 6*c/s*, Dec 6*g*
ID	Boise	Nov 20*g*
IL	Chicago	Nov 29*c/s*, Dec 11*g*, Dec 13*c*
MA	Boston	Dec 6*fu*, Dec 5*c/s*, Dec 13*g*
MD	Baltimore	Nov 15*gc*
	Bethesda	Nov 8*g*
MI	Dearborn	Nov 13*gf*
MN	Minneapolis	Nov 13*gf*
MO	Kansas City	Dec 12*gf*
	St. Louis	Nov 7*gc*
MS	Jackson	Nov 7*gf*
NC	Charlotte	Nov 6*f*
	Raleigh	Nov 29*gc*
NJ	Iselin	Dec 11*gi*
NM	Albuquerque	Nov. 27*gc*
NV	Las Vegas	Nov 1*g*
NY	Buffalo	Nov 1*gf*
	Long Island	Nov 14*g*
	New York City	Nov 28*g*, Dec 7*c/s*, Dec 11*fc*
	Rochester	Dec 4*gi*
OH	Cleveland	Dec 4*gf*
	Columbus	Nov 15*gf*
	Cincinnati	Dec 13*gf*
OK	Oklahoma City	Dec 11*g*
	Tulsa	Dec 12*g*
OR	Portland	Dec 12*g*
PA	Philadelphia	Nov 8*gu*
SC	Greenville	Dec 12*g*
TN	Knoxville	Dec 5*gf*
	Memphis	Nov 8*c/s*
TX	Austin	Dec 6*cg*
	Dallas	Nov 27*gc*
	Houston	Nov 13*g*, Dec 14*gc*
	San Antonio	Dec 11*gc**
UT	Salt Lake City	Nov 13*g*, Nov 27*c/s*
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WA	Seattle	Nov 7*gc*, Dec 13*gu*
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TEKTRONIX DROPS WORKSTATION LINE

Citing an overly crowded market and poor sales, Tektronix Inc. has put its workstation business on the auction block. If a buyer isn't found by mid-December, it intends to close the workstation business, the company has announced.

Tektronix's Strategic Marketing Manager Drew Davis says the "odds are against" a company buying the business, which had $40 million in sales last year and employs 175 people. He says Tektronix is closing the workstation business because it wants to free development and marketing dollars for such company growth areas as X terminals. The workstation business was requiring too large an investment, he says.

The workstation division made the Tektronix XD88 line, based on Motorola's 88000 family of RISC microprocessors. It will end all development, marketing, and sales of the XD88 products, but plans to continue support.

USER ALLIANCE PROMISES NO NEW CONSORTIUM

Is it yet another Open group? The User Alliance for Open Systems has joined the long list of new organizations with "open" in their names. The User Alliance, formerly known as the Atlanta 17 and the Houston 30, is a loose collection of information systems managers from such companies as Exxon, Ford, General Electric, General Motors, Kodak, and McDonnell Douglas. They believe that open systems are critical to keeping large North American companies profitable and competitive, and their focus is figuring out how to breach the barriers to open systems in large businesses.

Uncharacteristically, neither vendors nor the trade press are invited to participate in the User Alliance–it's strictly for users. Since the group's first meeting in February they've kept a low profile. That may be why they've already produced an interim report and decided *not* to form a new industry consortium. (The group may become associated with an existing organization with similar goals; they're currently discussing that possibility with the Corporation for Open Systems.)

Corporate open systems users interested in working with the group can contact Industry Cooperatives Services at 313-769-4454. Vendors and other interested users can get a copy of the group's mission statement, "Overcoming Barriers to Open Systems Information Technology," by sending their name and address in a one-page fax request to Janice Williams at Hughes Aircraft (fax: 213-816-6029).

NCR OPENS UP

NCR Corp. has been making moves toward becoming an open systems power. It has released Open Networking Environment, a set of OSI networking products aimed at moving businesses from their current SNA and TCP/IP networks to the OSI network. It has also released Cooperation, an integrating software environment for enterprise-wide cooperative computing. Cooperation integrates users, applications, information, and networks to improve productivity, says a company spokesperson. It is the first software product implemented under NCR's Open, Cooperative Computing Architecture.

The first release will run on any standard Intel 286-, 386-, or 486-based PC, either ISA or MCA bus, running DOS at the client, and any industry-standard Intel-based MCA

computer running current releases of OS/2 SE and UNIX V.4 as the server. Subsequent releases will support OS/2 and UNIX client workstations.

NCR has made other moves. This fall it announced a strategic alliance with The Santa Cruz Operation (SCO) to offer SCO UNIX System V/386 Release 3.2 and SCO's Open Desktop on its new System 3000 family of 386-based computers.

UNIX System V Release 4 has been NCR's only UNIX offering, but the move to SCO represents a commitment to a variety of UNIX implementations, says an NCR spokesperson.

In another move, NCR announced a partnership to provide nationwide maintenance for Sun workstations. NCR's customer service division signed a contract with Polaris Service Inc., a computer maintenance firm specializing in repairing UNIX workstations and peripheral equipment manufactured by Sun Microsystems.

A survey by International Data Corp. predicts the workstation hardware maintenance market will hit $329 million by 1994, up from $73 million in 1989.

INTERNATIONAL MARKETS REAP REWARDS

The popularity of open systems in Europe has pushed UNIX growth to higher levels, according to Maggie Konner, manager of International Data Corp.'s UNIX service.

In 1989 the international UNIX market grew twice as fast as the U.S. market, according to IDC data. The worldwide UNIX market grew more than three times as fast as the 5% growth in the overall systems market. Shipments of UNIX-based systems grew at 27%, to more than 570,000 units worldwide.

SUN OFFERS COBOL

Hoping to continue its drive into business markets, Sun Microsystems will offer a version of Cobol for its SPARC-based UNIX systems. Sun Cobol is an enhanced version of Micro Focus Cobol/2 from Micro Focus Ltd. It is compatible with many different Cobol dialects, including ANSI 85, ANSI 74, IBM OS/VS, and Microsoft.

A million programmers are creating $35 billion per year in Cobol software development, says Eric Schmidt, vice president of Sun's General Systems Group. He says Cobol is critical in letting Sun compete with IBM and DEC in commercial markets.

TRUCE FOR MOTOROLA AND HITACHI

Motorola and Hitachi have reached a settlement on intellectual property and technology disputes between the two companies regarding Hitachi's H/8 and H/16 microcontrollers and Motorola's 68030 and 88000 microprocessors. Settlement terms were not disclosed.

Motorola says it will file joint motions with Hitachi before the U.S. Court of Appeals for the Federal Circuit and the U.S. District Court for the Western District of Texas (Austin Division) requesting that all pending cases involving Hitachi's microcontrollers and Motorola's microprocessors be dismissed.

AMD SET TO LAUNCH 386 CLONE; INTEL THREATENS PC MAKERS

Advanced Micro Devices officially acknowledged in October that it's making a clone of Intel's 386 CPUs. The AMD chips, code-named "Longhorn" (a 386DX clone) and "Shorthorn" (a 386SX clone), are the most recent shots in a running technical and legal war between AMD and Intel. In the most recent round, AMD won an arbitration ruling that it hopes will bring it rights to Intel microcode and trademarks, while Intel sued to prevent AMD from using "386" as the name for its 386-compatible chips.

AMD's marketing plans for the chips came to light after documents intended for an AMD employee staying at a Silicon Valley hotel were mistakenly delivered to an Intel employee with the same name who had recently stayed at the same hotel. In spite of

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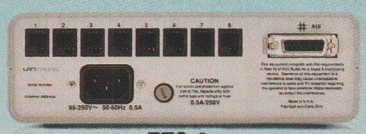
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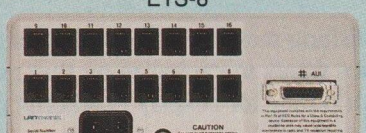
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three separate lawsuits related to the new chips, AMD is expected to roll out its 386-compatible CPUs before the end of 1990.

An AMD 386 could significantly reduce prices for high-end PCs and low-end, 386-based UNIX systems. AMD has been trying for more than three years to second-source the 386, while Intel is fighting hard to preserve the 386 monopoly. Intel claims "386" is its trademark, and says it will sue PC makers who use "386" as part of their products' names if there's not an Intel CPU inside.

SCO TO EASE UP ON OVERTIGHT SECURITY

The Santa Cruz Operation says it will make things a little easier for users who've had trouble with the new security features in SCO UNIX 3.2 Version 2.0. The company added the security features to qualify for the Defense Department's C2 security classification. At first SCO claimed the security features don't affect users at all and shouldn't give system administrators much grief, either. But some system administrators complain about the increased complexity of adding new users with the security turned on, and the apparent lack of a way to turn the security features off.

SCO says the next versions of its UNIX will address all those problems. According to SCO UNIX Product Manager Charley Watkins, the "security administration" menu system will be combined with the system administration menus to make adding users a one-step process, and setting security to a minimum will also require one step. Watkins also says SCO is working on a command-line interface for system administrators who don't like using SCO's menu system.

HP REALIGNS

Hewlett-Packard has realigned its computer business into two new units. The move is aimed at cutting costs, and will integrate workstation and multiuser system business units.

HP's computer business, which accounted for $8 billion in revenue last year, will be organized into two units: the computer system organization–workstations, engineering applications, multiuser systems, and networking products; and the computer products organization–HP's personal computer products and computer peripherals. Lewis E. Platt, HP executive vice president, will manage the computer systems organization, and Richard A. Hackborn, HP vice president, will manage the computer products organization.

HP has also established a "chief executive office," which will be shared by John A. Young, HP president and chief executive officer, and Dean O. Morton, HP executive vice president and chief operating officer. The Chief Executive Office will be responsible for strategic and operational management in all major business organizations, including the new units.

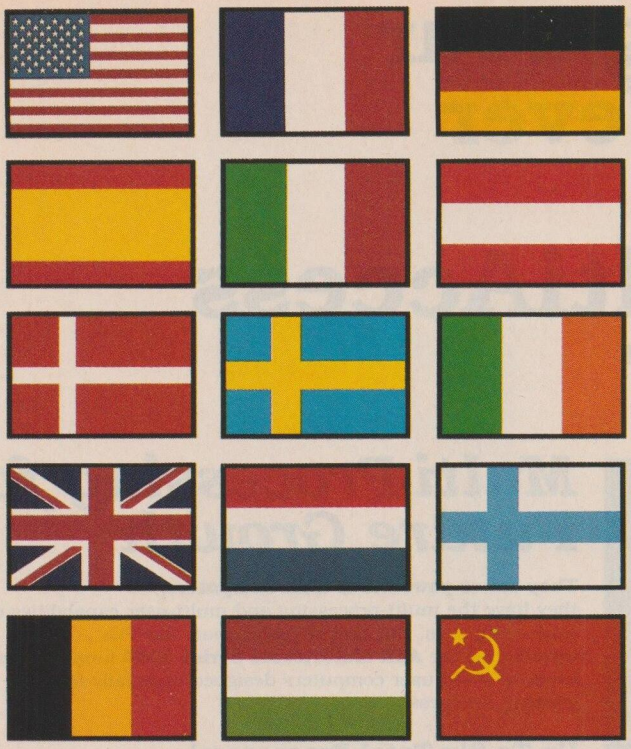
COLOR ME

The color publishing market is a growth area for UNIX workstations, say analysts, and Silicon Graphics wants to capitalize on that growth. It recently announced a licensing agreement with Adobe for Display PostScript to run on Silicon Graphics IRIS 4D workstations.

Silicon Graphics will combine the standards of X and OSF/Motif with Display PostScript to enhance support for color publishing software development, says Betsy Wahlquist, a spokesperson with Silicon Graphics.

CASE SOFTWARE SALES GROW

Computer-aided software engineering (CASE) software sales will quadruple from $672 million in 1990 to $2.9 billion in 1994, according to a study by the research firm, Frost &



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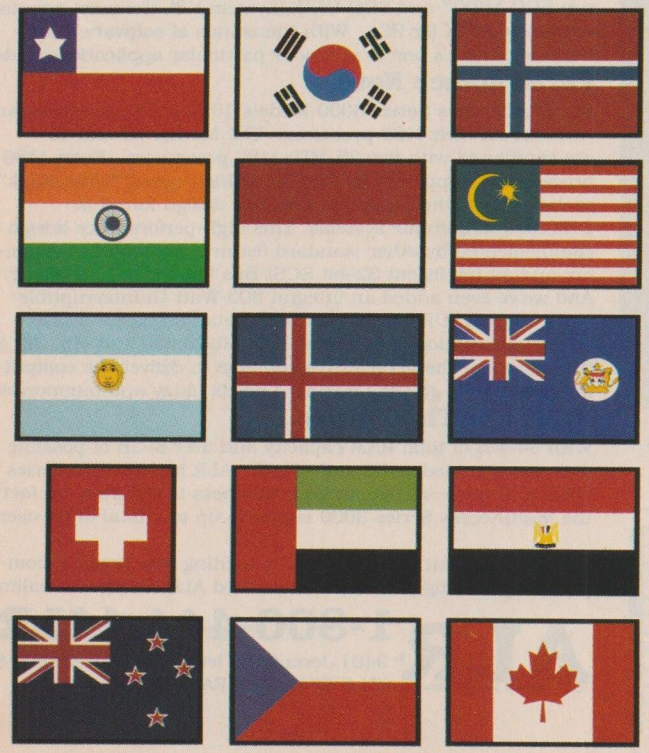

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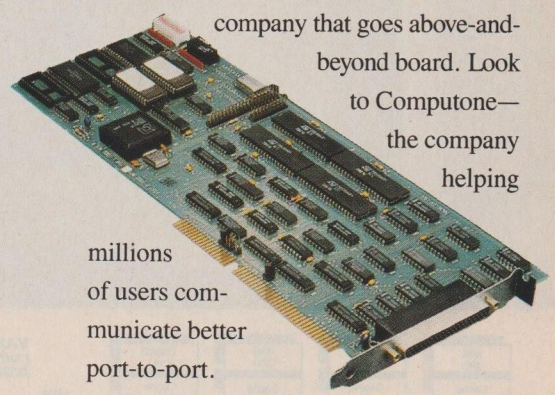

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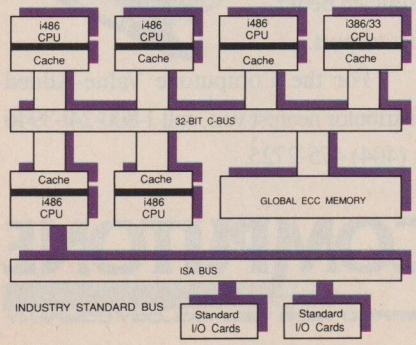
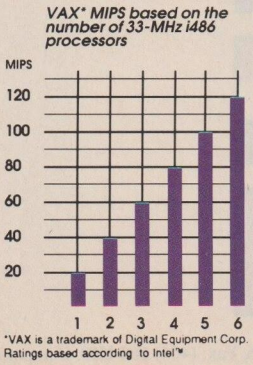


MultiAccess Series 3000 System Architecture



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CIRCLE NO. 14 ON INQUIRY CARD

Sullivan. According to the study, sales of hardware platforms used for CASE will nearly triple from $1.2 billion to $3.1 billion.

The reason for the demand comes from the increasing sales of computer systems, while qualified programmers continue to be scarce.

DATA GENERAL REORGANIZES

In an effort to bring profitability to its proprietary Eclipse and Aviion open systems product lines, Data General has restructured its operations and hired three new vice presidents.

Two of the three new vice presidents will give the company added UNIX expertise. Allan Jennings, formerly of the UNIX Systems Division at Unisys, will be vice president of the Aviion Development Group; and Bill Zastrow, former director of UNIX Product Marketing at Dell Computer, will be division vice president of the Open Systems Marketing Group.

The new organizational units–the Aviion Development Group, the Open Systems Marketing Group, the Eclipse Business Unit, and the Data Solutions Company–will provide Data General with a "more focused vision," says a company spokesperson.

Data General cut its workforce by 2,000 employees in August. A company spokesperson says the Aviion product line had met growth projections this fiscal year.

SILICON GRAPHICS STARTS COMMERCIAL SOFTWARE PUSH

In a move aimed at increasing its sales to commercial environments, Silicon Graphics has signed an OEM agreement with Informix Software Inc. Under the terms of the agreement, Informix's Wingz and On-Line software will be ported to the entire line of IRIS 4D workstations and servers.

On-Line is the first UNIX-based database engine to combine fault tolerant on-line transaction processing (OLTP) performance with support for multimedia database applications, says an Informix spokesperson.

UNIX IN THE CLASSROOM

The National Science Center Foundation (NSCF), a non-profit organization based in Atlanta, Georgia, has selected an open systems solution for a math program–Learning Logic–which will be the first computer program designed to replace math textbooks in classrooms. NSCF has purchased nine Motorola MultiPersonal Computer (MPC) systems. NSCF has designed Learning Logic to be open and capable of running on a UNIX server architecture, such as the MPC, or on a networked PC system.

NSCF President and Chief Executive Officer Fred C. Davison says that, "Some teachers are forced to teach math because of a lack of trained math teachers. With Learning Logic we hope to use technology to augment teachers' abilities." The NSCF estimates a U.S. shortfall of approximately 675,000 scientists and engineers by the year 2006.

OVERHEARD

"Do I think Larry Ellison feels humbled by this experience? No way. He feels like he has been betrayed. He's never going to change." —a disillusioned Wall Street analyst, after listening to Oracle's President and CEO Larry Ellison explain his company's recent troubles.

—Edited by Gary Andrew Poole with staff reports. Please send any breaking news or comments to him at: `uunet!uworld!garyp`.

LET YOUR DOCUMENTS DO THE WALKING

Interleaf is bringing distributed computing one step closer by incorporating its "active documents" technology into a family of products called Interleaf 5. The software enables you to automate the way your documents and applications are connected to each other, and imbue the document with its own intelligence and information-gathering capability.

For instance, you can make the ultimate representation of data on the users' screens dependent on their level of knowledge or responsibility within the company. You can also set up "live links," so that opening up one document automatically links to a particular file or database, and "dynamic links," so that changing data in the on-screen file updates the source.

In addition to targeting the fields of publishing, engineering, and academia with specific features (image editors, charts, layout capabilities), Interleaf 5 also includes a development environment for systems integrators. The software begins shipping this month on HP/Apollo, DEC, IBM, and Sun workstations, with prices ranging from $2,400 to $16,000.

RICHARD NIXON WOULD HAVE LOVED THIS

Apple says you're demanding highly integrated computers with small footprints. When it comes to audio, you want the option of putting the microphone on top of the monitor, on the desk, or clipped to your lapel. So even though Apple redesigned the new low-end Macintosh IIsi's enclosure, and the microphone picks up voices from several feet away, it's still attached via a jack in the back, to dangle any which way you want.

The IIsi also needs an upgraded version of A/UX 2.0. While the IIsi is available now, A/UX 2.0.1 won't be available until the first quarter of next year. Sources attribute the delay to porting the operating system to a new piece of hardware, but add that when 2.0.1 arrives, it will include support for multiple monitors, will be up-to-date on Posix compliance, and will include enhanced MacX software. Using a 20-MHz 68030 chip, the IIsi's cost is $5,700 for five megabytes of RAM and 80 megabytes of storage (it's only $4,900 for two megabytes of RAM and 40 megabytes of storage, but A/UX 2.0 and 2.0.1 require four megabytes of RAM).

YOU CAN NEVER BE TOO RICH OR HAVE TOO MANY SPARCSTATIONS

Having shown it's serious about the commercial marketplace, Sun's going back to its roots. The SPARCstation 2 series–made up of the GX, GS, and GT models in the same pizza box enclosure–is aimed at scientific and engineering users. It uses the 40-MHz SPARC chip from Cypress, and comes with 16 megabytes of memory standard (compared to eight for the SPARCstation 1). By putting buffering on the direct memory access (DMA) chip, Sun's estimating sustained throughput of 32 to 35 megabytes per second (compared to 20 to 25 for the SPARCstation 1).

Also coming out with the SPARCstation 2 are a couple of optional S-Bus cards that will work with SPARC-based clones. One add-on memory card fits in the S-Bus slot to give you a total of 96 megabytes of memory, while the other lets you expand your SCSI devices–up to 7.6 gigabytes of extra storage.

—Howard Baldwin

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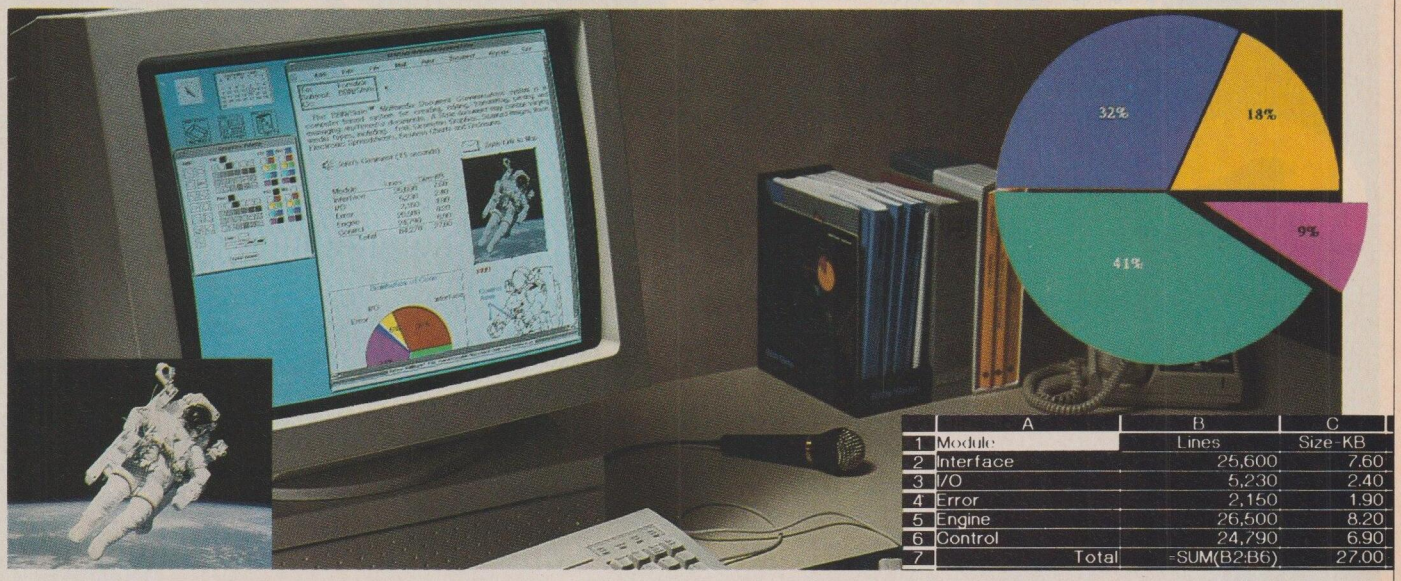

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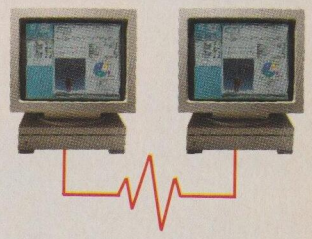

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CIRCLE NO. 139 ON INQUIRY CARD

READERS UPSET BY OUR BENCHMARKS

Editor's note: Mail continues to pour in about our teaser item in September's Industry News section, "Big Blue's RS/6000 Isn't White Lightning." It's the most mail we've had in a long time. For the full story on our benchmarks, and our rationale of using awk, read our in-depth product review on page 86. We're looking forward to your further comments.

Dear Editor:

I cannot understand why you printed such a misleading headline, "Big Blue's RS/6000 Isn't White Lightning." I also cannot believe anyone would use **awk** for a floating-point test. Perhaps you should send Neal Nelson a copy of "Fast Company" [*Editor's note: an article about compilers for RISC processors*] on page 78 of the same issue.

Next time use the XLC compiler included with AIX 3. Last March I tested the POWERstation 320 with a pre-release version of the XLC compiler. It ran a floating-point-intensive wave simulation 40 times faster than the same code on a 16-MHz PS/2 Model 80 with an 80387 and version 2.0 of Borland's Turbo C. No 486 can match that performance.

Your floating-point times on the RS/6000 must have been swamped by the overhead imposed by **awk**. I do not know why your integer times on the RS/6000 were slow; perhaps you used pre-release AIX software full of debugging code.

If you do not like to compile your own benchmarks, try using an application like Mathematica. It will soon be available for the RS/6000 and is already available for other UNIX platforms, PCs, and Macs.

Stuart Fogg
Oakland, Calif.

Product Reviews Editor Alan Southerton replies: You are missing the point of the UNIXWORLD/Neal Nelson Multiuser Benchmark tests–they are portable tests that run in a multiuser environment. That's why we did not use the XLC complier. As for the release of AIX, we were informed by IBM that it was commercial-quality code.

Dear Editor:

I am addicted to UNIXWORLD magazine. I go crazy the month I do not get it early. It is a very good and informative magazine. However, it looks like you were too anxious to present a report of "slow" performance on the IBM RS/6000, even through a non-confirmed report.

This is a very powerful machine. Our Informix applications are flying in this "not so lightning" platform. The UNIX market needed IBM to show its presence in the big way. Now there is no doubt about UNIX anymore.

Please do not compare this computer with a 486 PC. You should be a little more cautious about benchmarks before disclosing your opinions, or you can lose your view as an objective magazine.

Jose Angeles
Computer Consultant
Microcomputos, S.A.
Santo Domingo, Dominican Republic

Products Review Editor Alan Southerton replies: We question your need for "confirmed" results. We ran the UNIXWORLD/Neal Nelson Multiuser Benchmark, and we printed the results. That's all that happens. As for comparing the RS/6000 POWERserver 320 against a 486, we believe the comparison is on target because both offer viable server technologies.

And You Don't Like Our Story on Multimedia, Either

Editor's note: The second-largest pile of mail we've ever received results from our exclusion of the Commodore Amiga when discussing the topic of multimedia in the August issue.

Dear Editor:

In your August 1990 issue you had an article about multimedia. You mentioned how Apple is further down the road; also, that the major platforms consist of Apple, Intel-based PCs, Sun, and others. I expected, at least, some coverage about the Amiga.

An Amiga on the low end would run from $2,446.90 and up, which would include multitasking, color monitor, graphics and animation package, video titling, and a genlock to lock timing to dump images to video. The minimal offering from Apple would cost about $11,039 and from IBM $8,538, both without multitasking (according to a story in *Amiga World*). If you buy an Amiga 2000 or 3000 now you would get multimedia authoring with the package that also multitasks.

The Amiga has third-party cards to run Macintosh software and IBM clone cards for both XT and AT. These are unique because you can run PC software as a window while running other tasks. You also get a PC bus built into the computer, giving you access to all IBM clone hardware to include graphic cards.

The Amiga also runs UNIX, both AT&T and SCO versions, on the PC side. X Windows is available and can function on a DEC network. The 3000 comes with Arexx, a mainframe script language that is used to run multiprocess between different programs. A few universities have implemented Amigas as smart terminals, using Arexx to multitask with Crays and IBM mainframes.

With my subscription I had hoped you would not be another "Mac, PC, me too" magazine. I presently live in the United Kingdom, and I have researched all low-priced multitasking systems–CDOS, UNIX, and OS/2. Only Amiga offers high performance with low price and the ability to use coprocessors now, while the PC clone and Mac promise to provide that power sometime in the future.

In *Amiga World*, April 1990, there was an article about Commodore developing AT&T System V.4 that will support Sun Open Look graphics interface. Here in the U.K. and Europe, Amiga 2500HDs already run UNIX.

Apple, Next, Microsoft, AT&T, and IBM spend quite a lot of advertising money, but obviously are not the most advanced or best products on the market. May I suggest you re-evaluate your article and do some comparisons of the Amiga system with the other platforms mentioned.

Arthur L. Ingram
U.S. Air Force
England

Dear Editor:

I could not believe my eyes as I skimmed through your August issue's multimedia article and could not find even a mention of the Amiga. The Amiga has become, for me and a large part of our organization, the vital workstation that can pretty

much "do it all." What really peeves me is that after doing much researching and head-banging, I decided to buy one of these workstations for myself. I have just invested in Commodore's newest Amiga, the 3000.

You are obviously not familiar with this machine. Most important to you should be the fact that Commodore is about to release UNIX V.4 along with Open Look. How did I find this out? Certainly not from reading UNIXWORLD. Luckily, I have access to Internet.

It is, however, common knowledge that the Amiga is best suited for multimedia, thanks to its multitasking, standard graphics/sounds/animation file-formats, blitter, and video output capabilities.

It would be nice for a magazine that covers the *"perestroika"* of operating systems to be fair to all machines.

Stefan Buchholz
System Administrator
MITE Avista
Concordia University
Montreal, Quebec, Canada

Editor's reply: Well! Quite a few snappy rejoinders in these two letters. First of all, you're right: we goofed. Second, we've been following the progress of the Amiga/AT&T System V machine and we'd like to review it, as soon as the latest port of the operating system ships in the U.S. Stay tuned.

I Do Love UNIX, Truly I Do

Dear Editor:

I was charged with "UNIX bashing" by Michael Snyder in the September issue after my first letter appeared in the June issue. It was because I said the cost of UNIX software is higher than the cost of equivalent DOS software. Obviously, I did not get my point across. May I try again?

First, I program in both the UNIX and DOS environments, and do all my initial work in UNIX. Anyone who has ever used the Korn shell with command line editing and command history, along with the rich package of UNIX utilities, probably won't want to spend much time programming in the DOS environment. I do understand the great amount of effort in developing a clean program for the multiuser system. I really do love UNIX, honest!

Some 17 million PCs will be sold this year (UNIXWORLD, September 1990), mostly in a single-user environment (not networked) and mostly running DOS. Vendors like SCO would be making a good long-term investment by tapping this market. SCO should cut the price for single-user versions of their UNIX system and application software to the bone. Once the increasingly sophisticated DOS users out there discover the joys of UNIX, they will not go back. Many of them will ultimately make the decision to go multiuser, and will buy lots of good high-priced, complicated multiuser software.

Microsoft understands this concept. It sells Windows 3.0 for more than $90.00 (discounted price). It knows that by upgrading the capabilities of the DOS system, it can keep most DOS us-

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David L. Bigelow
Kailua, Hawaii

Benchmarking for Remote Terminal Emulation

Dear Editor:

Thank you very much for sending me the description of the UNIXWORLD benchmarks. I was particularly interested in the use of remote terminal emulation.

While benchmarking products that run on the target system, such as MUSBUS, are relatively easy to set up and run, the use of separate computers to emulate VDU activity provides more control of the load generated, more precision in the measurement and recording of results, and more realism in the recreation of a workload.

In the past I have used PCs to emulate serially connected VDUs. This technique has been successful for benchmarking and is also useful for repeated, scripted, functional tests. I now have a requirement to conduct such benchmarks on a range of UNIX machines where the VDUs are to be connected via terminal servers to an Ethernet using Telnet. It would, of course, be possible to use PCs to emulate these terminals, but it would be more convenient if they could be emulated by a second UNIX processor connected using Ethernet to the system under test. Are you aware of any products or techniques to support this requirement, which would enable such a test to be conducted quickly and easily?

I can also foresee the need to conduct this kind of benchmark using X terminals or workstations instead of simple VDUs.

Mike Byles
British Telecom
Principal Consultant
London, England

Editor's reply: There are several commercially available remote terminal emulators that might be able to provide you with this capability. They are available from: A&T Systems, Silver Springs, MD 301-384-1425; Neal Nelson & Associates, Chicago, IL 312-332-3242; Performance Awareness, Raleigh, NC 919-878-1750; and Performix, McLean, VA 703-749-1452. You can obtain information about our benchmarking procedure by writing to UNIXWORLD, 444 Castro St., Mountain View, CA 94041, and requesting it.

Correction

In the November issue of UNIXWORLD, two product photographs were inadvertently switched. The photo of James River Group's Ice.Ten terminal emulator, Deja Vu, on page 113 should accompany the product review for that product on page 127. The photo of VisionWare's XVision on page 127 should appear on page 113. The editors regret this error.

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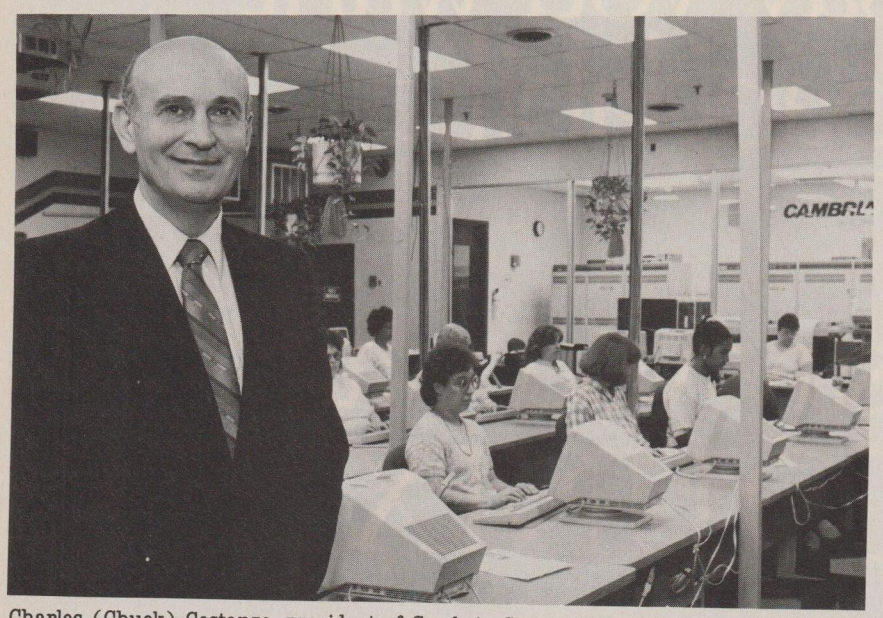

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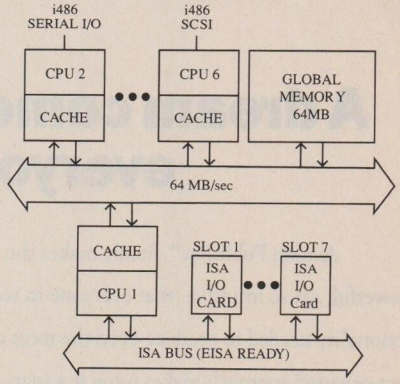

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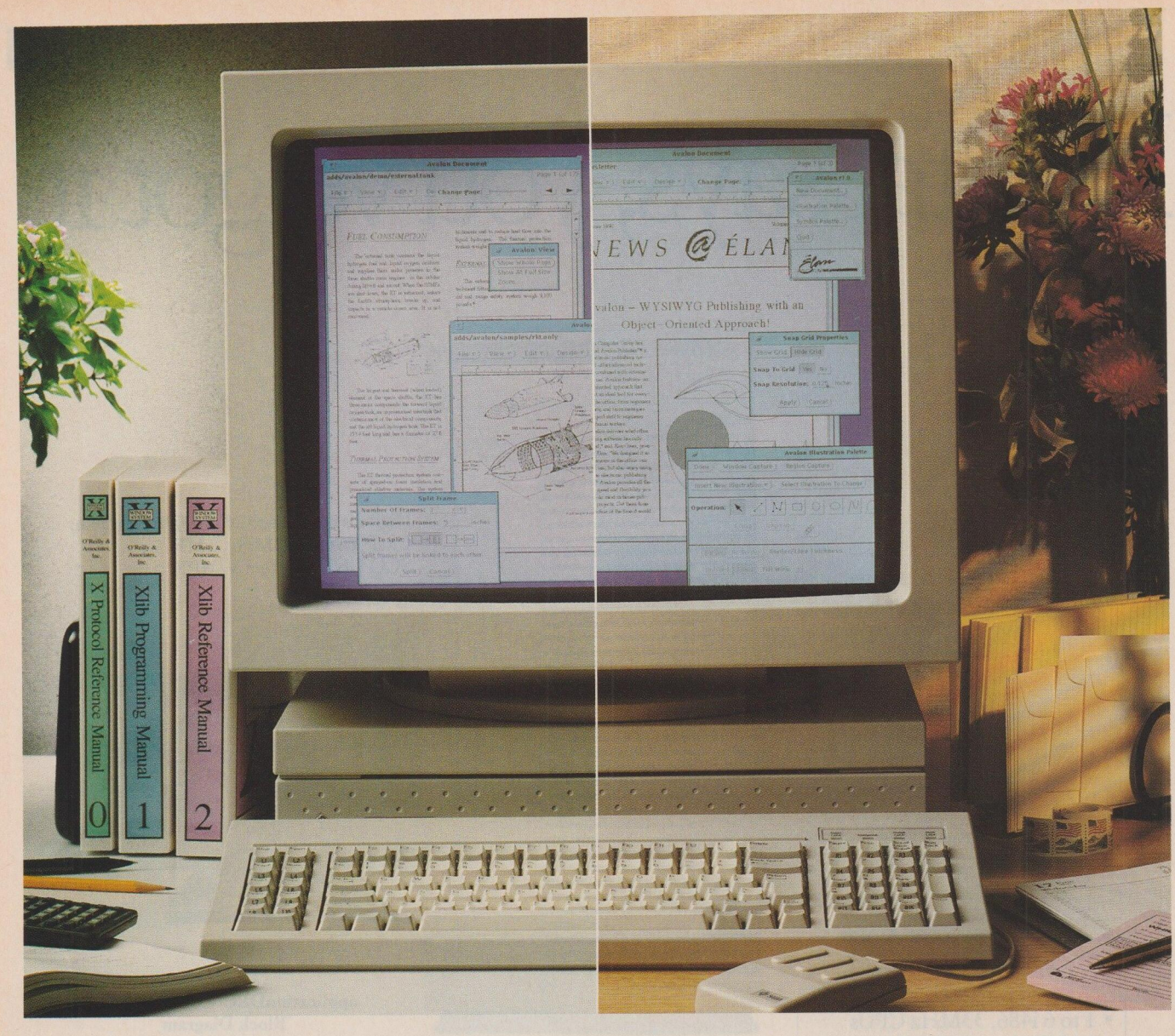

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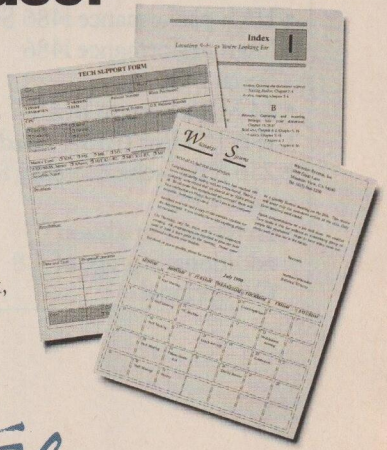

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CIRCLE NO. 32 ON INQUIRY CARD

Reviewed by Walter Zintz

SAYING THINGS VISUALLY

For every solution there is a new set of problems. Visual displays illustrate this truism rather well. High-resolution, full-color, bit-mapped workstation screens make information presentation a lot more effective for power users in such areas as engineering and graphics arts. But the rest of us are left wondering what to do with all this visual power. This month's selection of books covers how to best communicate information graphically and how to begin using the X Window System.

ENVISIONING INFORMATION

By Edward R. Tufte
Graphics Press; 800-822-2454, 203-272-9187
126 pages; 5 pages of Index & Contents
ISBN 0-961-3921-1-8 hardbound, acid-free pages; $48.00

Craftsmanship is the glorious rule here. In years of book reviewing, I've never seen a better produced book than this one. Pages are printed on fine paper in up to 12 colors. Page layouts are interestingly varied, without seeming random. Even the dust jacket would make an appealing poster.

The subject is graphic communication of every sort. This book is equally applicable to creating computer screen displays or laying out bus timetables. Instruction on how-to-do-it makes up almost half of this book. The other, larger half covers how to think about the graphic images you need.

Graphic art requires that two-dimensional images adequately represent three or four dimensions. Often an image must convey a lot of detailed information, without confusion and without losing the big picture. Relevant information must stand out from the irrelevancies. Color and shading must convey information, even though they may not be a natural part of the material being presented. These are Tufte's major themes.

All these ideas require good explanations. The author delivers them in a mix of his own well-wrought prose, apropos quotations from celebrated visual communicators, and examples of good (and occasionally bad) design. His opinions are here at times, too, and his outlook is artsy rather than pop.

You're not likely to agree with every last idea in this book. There definitely are a few ideas here that I don't accept. Frankly, that's the book's other strong point. This book is definitely a thought-provoker.

This book would serve far better than most as required reading for a graduate course in graphic communications. Surprisingly, it would be just as accessible and helpful to a thoughtful computer user working with screen design. It's a think book rather than an easy, breezy read, but it's also for everyone who's interested in visual displays that really communicate.

Review Highlights

Technical Level: Non-technical
Understandability: Almost Crystal-Clear
Summary: The why and why not of graphic information display, written for pros and beginners.

THE X WINDOW SYSTEM: A USER'S GUIDE

By Niall Mansfield
Addison-Wesley; 617-944-3700
344 pages; 41 pages of Index & Contents
ISBN 0-201-51341-2 paperbound; $22.95

This book is aimed at the end user, sitting at an X workstation or terminal and wondering just what needs to be done next. It comes across as the print equivalent of an X guru sitting at the next desk who's quite willing to answer any questions you might have.

This imaginary guru is both understanding and patient. Reading this book is no strain, even though you may not know anything about X at the start. All you really need to know is a little about UNIX, plus the basics of using a keyboard and a mouse.

Mansfield begins with a brief overview of X, dropping into matters as elementary as "What is a window system?" He puts this overview at the start of his book, but I'd save an in-depth reading of this section for last. Even at this elementary level, it will mean a lot more to you when you've had some actual experience with X.

The great majority of his book is how-to explanations. A little less than half of this tells you how to interact with X. The rest deals with presetting the way X will act or react in particular situations. At almost every point the explanations are step-by-step in plain language, stressing methods over theory. To make things clearer still, there are frequent examples of actual input and ouput. Numerous illustrations, both screen dumps and diagrams, cover matters that aren't easy to explain with words.

Several appendixes tell you where to turn for more help. There's a guide to documentation and other information that comes with X itself. Another appendix tells you just what is in the official X release, program by program. For users who can't find all of this on their systems, sources in the United States and Europe for complete, official X distributions are listed. Because Gnu Emacs is a favorite editor among X users, there's a source for that given, too. Finally, there are hints on installing X for those who need to do so, and a list of parameters you'll need to get from the system manager where X is already up and running.

This book concentrates on official, standard X, with very few digressions into outsiders' variants and additions. For example, the only window manager Mansfield discusses is `uwm`, which is the only one in the official release.

After reading this book, the only user problem you're likely to encounter is

one that the author couldn't be expected to resolve. It's in the basic X Window System. With X or with any other known window system for color bitmapped screens, you've got powerful and flexible output coupled to agonizingly pokey input capabilities. Keyboards are left over from the narrow focus of alphanumeric terminals, and they're barely adequate even there. A mouse is about the most cumbersome pointing device you're likely to encounter, but most X programs assume that your pointer will be a three-button mouse.

It seems evident to me that the next breakthrough in visual computing will be an input system as flexible as output already is. Until then, this book is a very good guide to getting along with what we've got.

Review Highlights

Technical Level: Beginner to Advanced
Understandability: Lucid Plus
Summary: The end user's guide to power X usage without tears.

BOOK BRIEFS

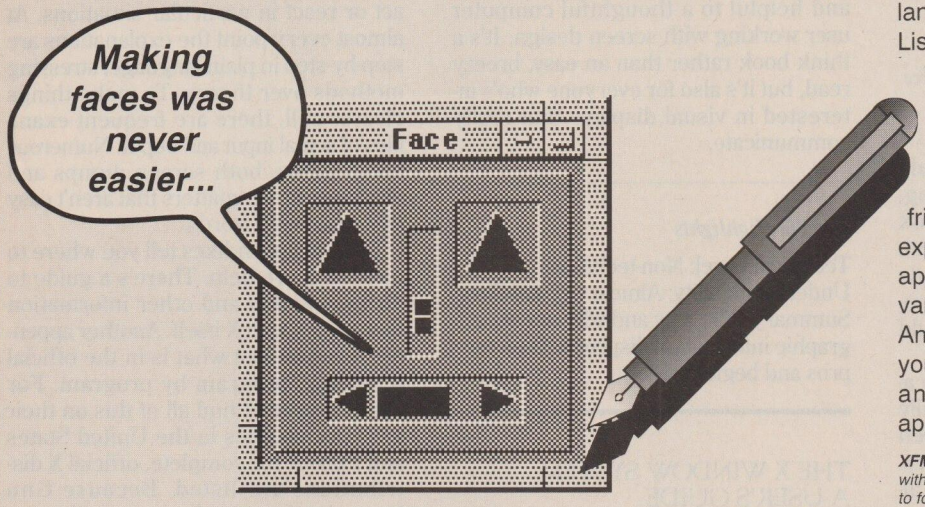
The Visual Display of Quantitative Information, by Edward R. Tufte (Graphics Press), focuses the author's aptitude for visual thinking into a thorough analysis of display techniques for strictly numeric information.

Two publishers offer quick-reference handbooks for X. *The X Window System in a Nutshell*, edited by Daniel Gilly and Tim O'Reilly (O'Reilly & Associates), features short blurbs and syntax templates. Entries are listed by command name or subject heading. X Window System *Technical Reference*, by Steven Mikes (Addison-Wesley), favors multipage tables, which can be arranged by anything from command names to hex values. Both these books are primarily of interest to application software programmers.

Also for programmers, John David Miller has written a code-rich *An OPEN LOOK at UNIX: A Developer's Guide to X* (M&T Books). This one's a semi-official book, done by a programmer who's not an AT&T employee but who did work in cooperation with AT&T on it. Douglas A. Young has now brought out an OSF/Motif edition of his well-done *The X Window System: Programming and Applications with Xt* (Prentice-Hall).

Because DEC was the co-developer of X, it's no surprise that Digital Press has expanded its offerings on X. They've added *X and Motif Quick Reference Guide*, by Randi J. Rost, and *X Window System Toolkit*, by Paul J. Asente and Ralph R. Swick. They also have a second edition of *X Window System*, by Robert W. Scheifler and James Gettys with Jim Flowers, Ron Newman, and David Rosenthal. These books, too, are primarily for programmers.

Editor-at-Large Walter Zintz is the Advisor Emeritus to Uni-Ops Books in Boonville, Calif.



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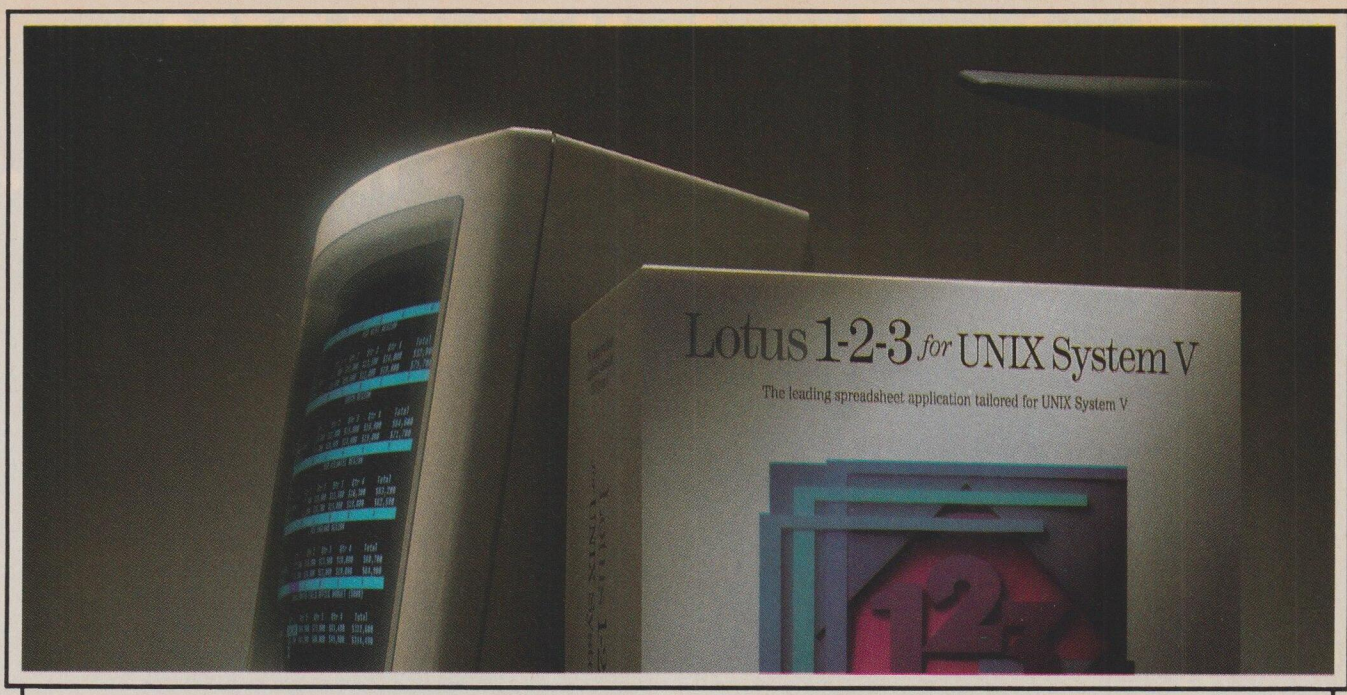

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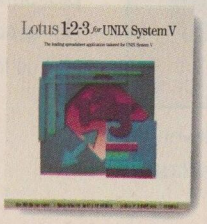

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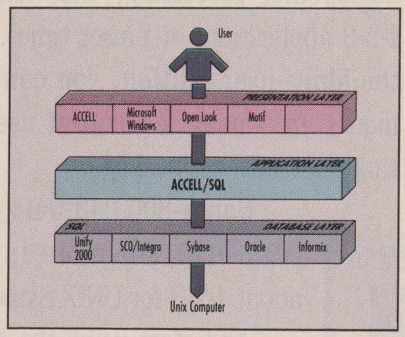

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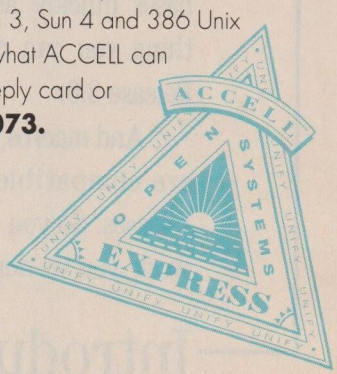

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CIRCLE NO. 168 ON INQUIRY CARD

Omri Serlin

AT&T Ramps Up To Produce Multiprocessing UNIX

You may recall that in my July column, I predicted that AT&T would have to speed up its planned multiprocessing enhancements to System V Release 4 (SVR4). I also noted the surprising absence of support for Open System Interconnection (OSI) networking in SVR4.

AT&T must have been listening. In September, its UNIX Systems Laboratories (USL) subsidiary announced a plan to incorporate some multiprocessing support in SVR4 by mid-1991. It also announced an open distributed computing "product direction," promising support for the middle and higher levels of the OSI Reference Model, also by mid-1991.

Other key offerings in the USL announcement included the release by year-end of a high-availability file system for SVR4; by mid-1991, a B2-level enhanced security feature (SVR4 ES) and enhanced remote operations and maintenance support; and by 1992, an advanced-architecture multiprocessing feature.

AT&T had to speed up multiprocessing support because its competitor, the Open Software Foundation, is now releasing its first operating system, OSF/1. This product has inherent multiprocessing capabilities. If AT&T did not follow suit, SVR4 would have had a considerable marketplace disadvantage.

Not everyone agrees with my assessment. David Sandel is vice president of marketing for UNIX International (UI), the consortium that is working with AT&T to promote SVR4. He told me that OSF/1 was not a consideration in any of the announced USL plans. Rather, he explained, the announcement was the expected USL response to the UI "Road Map" document (refer to the July column for a summary of that document). Any acceleration in the multiprocessing feature, Sandel insisted, is a response to requests from UI members who felt that the original 1992 date for the Multiprocessing Plus release of SVR4 had to be expedited.

The availability of a standard UNIX approach to multiprocessing will clearly be beneficial to users, who are currently facing a bewildering array of incompatible UNIX multiprocessing options from such companies as Sequent, Pyramid, NCR, and a host of others. In addressing the diverse range of available architectures, AT&T wisely decided to focus on the tightly coupled multiprocessing segment, as recommended by the Road Map. This means multiprocessing UNIX will be tailored to systems that allow all processors to execute programs and access data in a common, shared memory system.

Multiprocessing Now, Parallelism Later

The new, accelerated plan now consists of two steps. The first, a less ambitious undertaking than the Road Map goal, is dubbed the "standard symmetric multiprocessing," or SVR4 MP. It is scheduled for general availability by mid-1991, with early access to UI members in the first quarter.

The full realization of the Road Map multiprocessing vision, termed "advanced-architecture multiprocessing," is to be released sometime in 1992, with early access to UI members in the third quarter of 1991. Officially known as SVR4 ES/MP, this release will combine enhanced security (see below) with the full multiprocessing support.

To achieve the accelerated schedule, the initial SVR4 MP release will have a number of significant limitations. It will be designed to support a maximum of 16 processors, and it will not provide the threads or lightweight process construct. The latter restriction means that this release will not provide a standard mechanism for supporting parallelized applications.

Still, to support even this limited multiprocessing capability, AT&T and/or USL will have to do a substantial amount of work. All components of the operating system, including Virtual Memory (VM), Virtual File System (VFS), I/O and Streams, RFS, Network File System (NFS), TCP/IP, Unified File System (UFS), and System V File System (S5) will have to be converted to "multithreaded" operation. This is necessary so that multiple processes running concurrently on the multiple processors would not create confusion by simultaneously invoking the same service. Locking is the key mechanism to achieve such assurance. In SVR4 MP, locking will be "coarse grained," meaning that each lock, when invoked, will protect a large chunk of the operating system.

A key problem in multiprocessing support is that I/O drivers must be made aware of the multiprocessing environment. To this end, USL plans to extend the SVR4 standard Device/Driver Interface and Device/Kernel Interface (DDI-DKI) to include the use of locks, as well as to support other interface details required for multiprocessing. This specification, which is already under UI review, will allow OEMs and independent software vendors (ISVs) to begin developing device drivers and Streams modules that take full advantage of the multiprocessing capabilities.

The SVR4 MP product is under joint development with Intel for the 386, 486, and 860 microprocessors; Motorola and Unisys for the Motorola 88000 RISC chip set; and NCR, Olivetti, Oki Electric, and others, USL notes. Manufacturers who have or are developing their own multiprocessing UNIX versions and have endorsed the extended DDI-DKI include ICL and Sun, using the SPARC architecture; Pyramid on the MIPS architecture; and AT&T Computer Systems for the MIPS and Intel architectures.

Although SVR4 MP will not offer a standardized method of creating parallelized applications, it will support the concurrent execution of multiple, unrelated processes, leading to improved system throughput. Furthermore, its implementation will adhere to existing standards, especially the SVR4 SVID and ABI, X/Open's XPG3, and the DDI-DKI. Thus, existing SVR4 applications will be able to run on SVR4 MP as well.

The more ambitious "advanced architecture" version of multiprocessing support, dubbed SVR4 ES/MP (for Enhanced Security/Multi-Processing) will include all of SVR4 MP capabilities. In addition, it will provide support for parallelized applications–those that

take advantage of the concurrency in multiprocessing systems to speed up the execution of each application. This speed-up is in addition to the system throughput advantage of multiprocessing systems realized by SVR4 MP. Finally, it will accomplish all this for systems with as many as 30 processors, and atop an enhanced-security feature.

The most obvious external new features will be the support of threads, and a standard multiprocessing Application Programming Interface (API). Threads, or lightweight processes, are subdivisions of a UNIX process that share the process' resources, especially address space and files/devices, but which are dispatched rapidly as independent units that could run concurrently on multiple processors. This is the key feature of Mach, the basis of OSF/1.

The multiprocessing API is a set of system calls that will allow application processes to create and manage threads, as well as invoke locks, create synchronization barriers (i.e., points at which multiple threads must wait for each other), and use other mechanisms and primitives to facilitate parallelism.

The model AT&T has chosen for this release is the Sequent implementation of multiprocessing UNIX dubbed Dynix. The reference implementation of SVR4 ES/MP for the Intel 386/486 architecture will be on a Sequent Symmetry system. However, other reference implementations on MIPS, Motorola, and SPARC architectures will also be developed.

In addition, USL promises that it will also conform to evolving standards in this area, including the IEEE P1003.4A "pthreads" and P1003.14 multiprocessing efforts. The planned API for SVR4 ES/MP will be a superset of these activities, USL says. In addition, the new system will conform to the XPG4 and IEEE 1003.1a and 1003.2 standards.

Considerably more work is required for the advanced-architecture multiprocessing release, in addition to developing the threads and multiprocessing API concepts. The multithreading of the kernel and all operating system modules must be on a finer grain in order to support twice as many processors.

Furthermore, the entire subroutine library system must be reworked to make the subroutines executable by multiple threads concurrently. This means all subroutines must be made re-entrant, or "thread-safe." USL says it would do this for `libc`, `libm`, and `libnsl`.

Some UNIX services can take advantage of concurrency, as well. Make and Streams are the most obvious candidates for parallelization.

For real-time applications, as well as for systems that aren't fully symmetric, the notion of processor binding is useful, whereby specific processes can be assigned to specific processors, suppressing the costly process migration operation. SVR4 ES/MP plans to support this capability, as well. Finally, a new debugger and enhanced Operations & Administration tools will be provided for the parallelized environment.

Enhanced Security: Not a Blanket

Protection of computer systems against unauthorized access, either intentional

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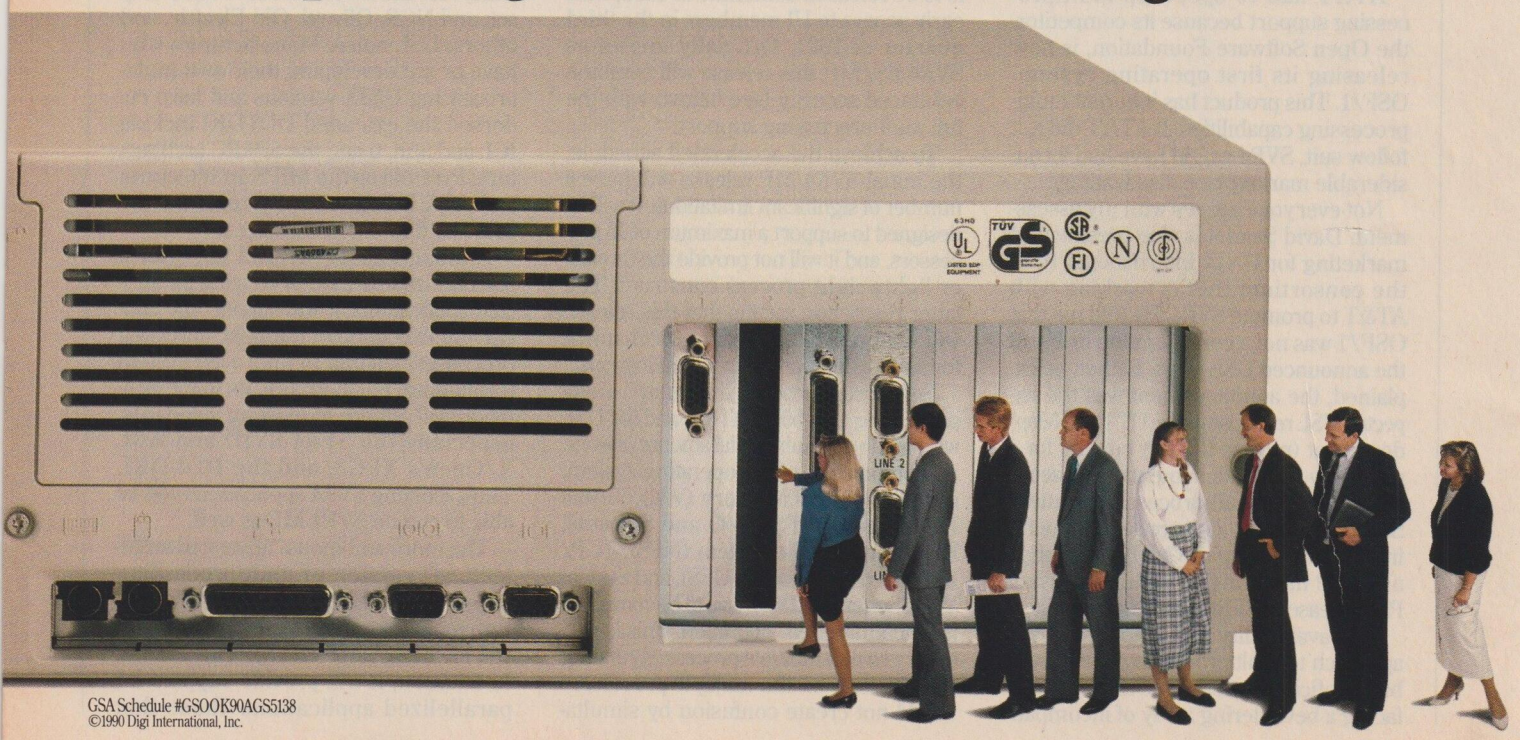

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or accidental, has been a key concern of the U.S. Defense Department for quite some time. Similar concerns are increasingly being shared by commercial users with mission-critical on-line systems. While providing some basic access control mechanisms, the UNIX system so far has been notorious for its many open "back doors," which made it the principal target of attacks by break-in artists. AT&T/USL would like to change all that with the Enhanced Security release, SVR4 ES.

This release will add the features necessary to meet the Defense Department National Computer Security Center (NCSC) level B2 certification, with some level B3 features, as well. According to USL, B3 is the highest security level that UNIX can achieve without a major restructuring of the entire operating system and its services.

AT&T already has a product that has been certified by the NCSC's B1-level certification. This is the so-called Multi-Level Security (MLS) feature based on SVR3, which was developed in response to the Air Force's AFCAC procurement and requirements formulated by the Swedish government. Recently, Amdahl Corp. announced that MLS would be available with its new mainframe running UTS Release 2.1.

Plans call for MLS to be available for SVR4 in the first quarter of 1991. But SVR4 ES will clearly go beyond MLS in order to attain the higher B2 rating. Early access to SVR4 ES is under way now, with general availability planned for mid-1991.

A key problem with secure UNIX is that it needs equally secure applications to make a sensible whole. So far, there are no such applications, although a few are under development. Informix has announced plans for a secure version of its Informix-OnLine RDBMS, available in mid-1991. It hopes the product will be certified at the B1 level on three UNIX platforms. Oracle Corp. is also known to be developing two secure versions of its RDBMS. Oracle Version 7 will aim for the C2 security level, while "Trusted Oracle" is targeting the B1 level. Either should work with both AT&T's SVR4 ES and the secure OSF/1, according to Raymond Wong, manager of Oracle's Trusted Systems group.

Earlier this year, Sybase announced that it had shipped a product designed to meet the B1 security level. The Sybase Secure SQL Server product implements the necessary security features internally, and thus, is not dependent on the underlying operating system. Indeed, the Secure SQL Server is running on DEC VAX using Ultrix, which has no NCSC security classification at all.

Even though the "advanced" multiprocessing release is predicated on the ES release, AT&T indicates that ES will be offered as a separately licensed, modular add-on feature, rather than bundled with the basic operating system.

Unfortunately, there isn't enough space left to delve into the details of secure UNIX, as well as the other portions of the USL announcements. I plan to return to these issues in a future column. □

Editor-at-Large Omri Serlin heads ITOM International Co., a consulting and research firm based in Los Altos, Calif.

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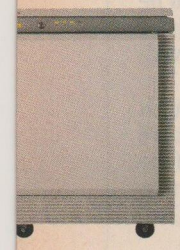
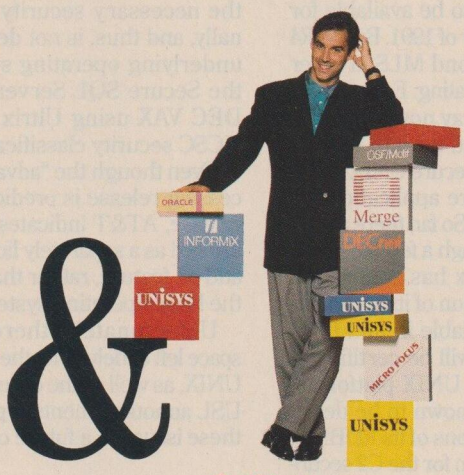


nultiple processor
users.



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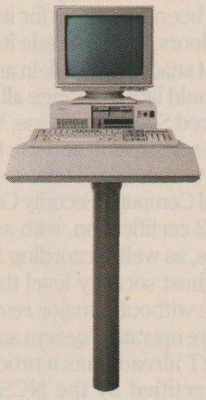

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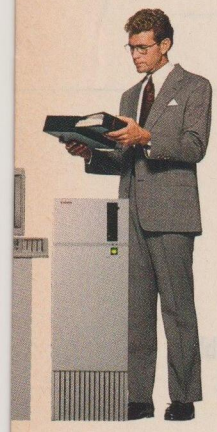

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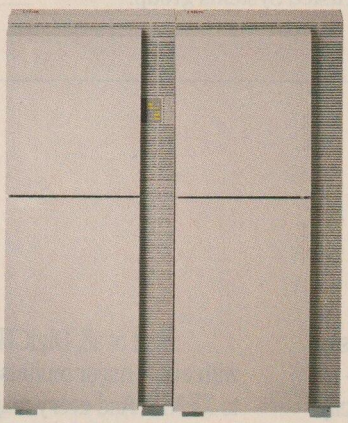

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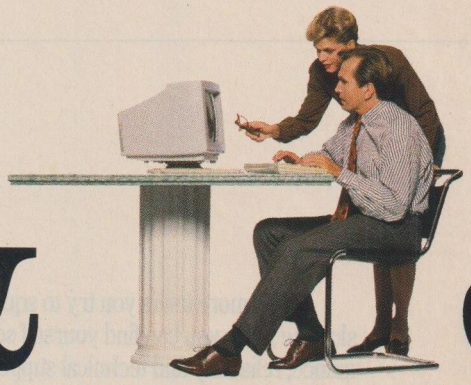

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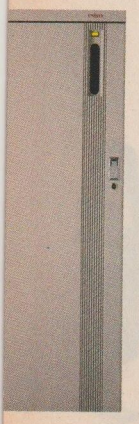

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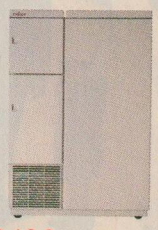

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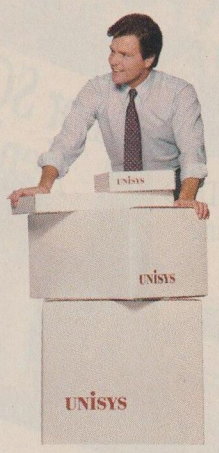

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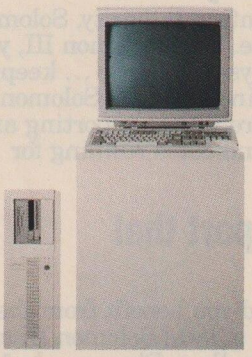

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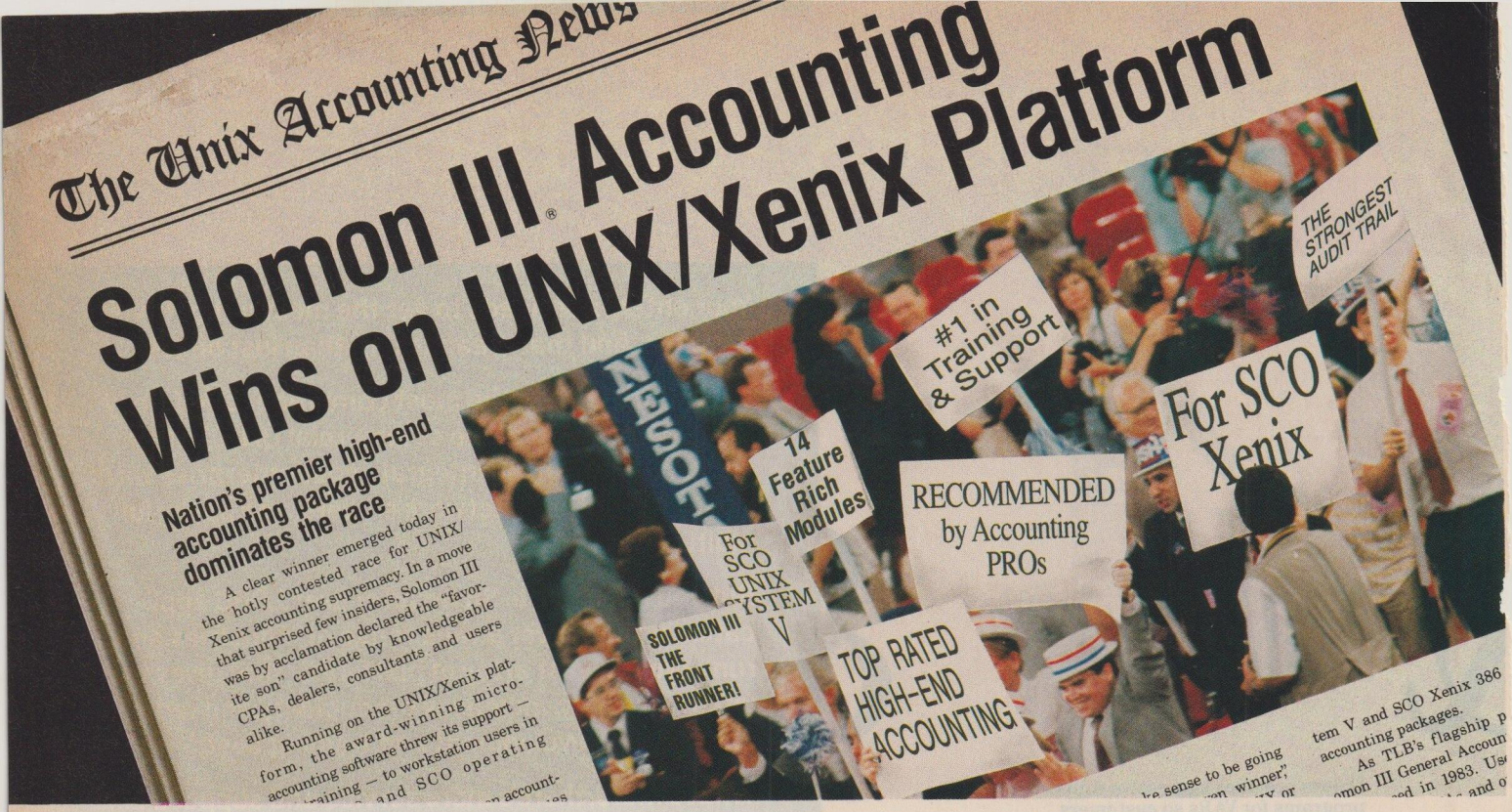

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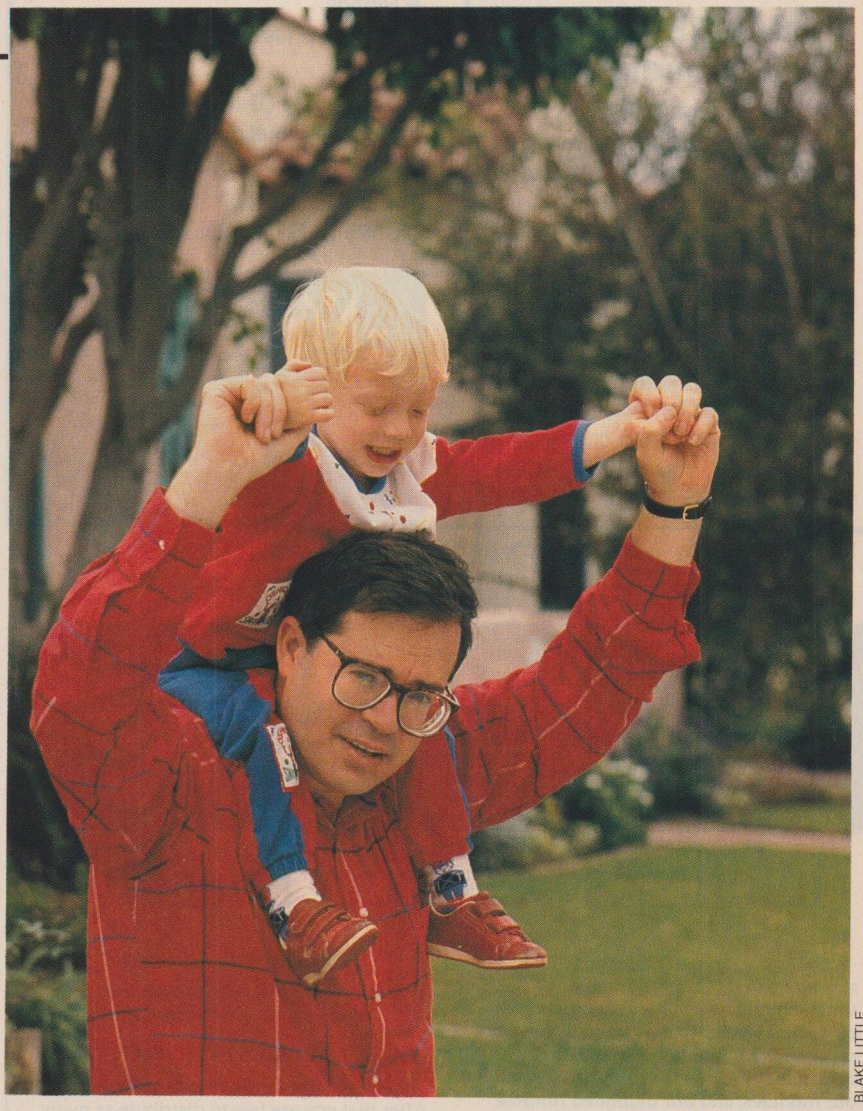
MULTIPROCESSING PCs, BY GEORGE!

By Howard Baldwin



BLAKE LITTLE

In 1893, the Duryea brothers combined two technologies. They put a single-cylinder engine on the back of a carriage and became the first American manufacturers of an automobile. In 1985, George White had a similar inspiration. What if you harnessed the multiprocessing power of a minicomputer in the standardized environment of a personal computer?

The world did not beat a path to his door. In fact, venture capitalists shunned investment in his company, Corollary. His company's first product slowed down as many machines as it sped up; and even one of his own partners abandoned the effort.

Today, five years later, White's lightning has begun to strike the computer industry. Corollary's multiprocessing kernel (the part of the operating system that directs the hardware), designed by White and his partner, Alan Slipson, powers SCO UNIX MPX, The Santa Cruz Operation's PC-based multiprocessing operating system. White has penned a technology agreement with DEC. And Corollary's multiport subsystem will be used by Hewlett-Packard and Advanced Logic Research for their PC products.

Meanwhile, other mainstream PC vendors have discovered multiprocessing, thereby vindicating White. Compaq, Wyse Technology, and Zenith Data Systems have recently produced multiprocessing machines.

Now George White looks like a pretty smart guy. "Sometimes I think what we're doing is sort of modest," shrugs White. "Other times I think, no, we're really at the center of the collision between minicomputers and PCs. For several years we were out trying to convince people it was a neat idea, with nobody trying to copy us."

Down to Earth

White's down-to-earth nature seems to stem from his roots. Neither of his parents went beyond high school. His father fixed radar systems, and one of the few books in the house was about oscilloscopes. That was how White became interested in electronics in high school. He went on to graduate from MIT with his engineering degree.

Stints at Western Digital and Texas Instruments followed, and it was at the latter that he first became involved with multiprocessing. He and Slipson, among others, were building a single-user scientific workstation based on Motorola's 68000 chip. The machine

"For several years we were out trying to convince people it was a neat idea, with no one trying to copy us."

—George White,
president of Corollary

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was called the NuMachine, and all that's left of it is the NuBus found in Apple Macintoshes. Even though White was chairperson of the IEEE 1196 NuBus committee, when he's asked what he'll be remembered for, the NuBus does not leap to mind.

In 1985, the NuMachine research group was "made redundant," White says, by internal TI rearrangements, and given the choice between moving to Texas or staying in southern California, White chose to stay put. He had always wanted to start his own company, so he and Slipson each pooled $5,000

White attributes his and partner Slipson's success to their willingness to share with employees a demanding work ethic.

from his severance pay to start Corollary. Following White's inspiration, they targeted multiprocessing on the PC. Multiprocessing meant multitasking, which meant writing a check to AT&T for $43,000 to pay for a UNIX source license. Doing it on a PC meant a second check for $25,000 to Microsoft for a XENIX source license.

The only venture capital they ever got was $250,000 in 1985. When their first product, Attain, a multiprocessing board for the PC AT, was ready to go to market in 1987, the response from venture capitalists was, "UNIX is RISC and PCs are DOS. What are you talking about?," White relates, expressing his pleasure now. "I own more of the company, and have fewer people involved in the company than I would have otherwise."

That's what makes White different from your run-of-the-mill entrepreneur. Not only are there no plans for an IPO, but along with partner Slipson, White is one of the lowest paid professionals in the company. "Our theory is that we ought to be among the lowest paid, because we have a lot more stock," he says. "We're asking people to work hard and make sacrifices. The only way for us to have some sort of moral authority is for people to see that we're sacrificing, as well. I prefer that to the idea of company founders who are making three times as much as everybody else."

He still drives the same BMW he did 10 years ago, except this year, he

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splurged and had it repainted. He still lives with his wife and family in middle-class Long Beach, not too far from the water, just as he did as a TI engineer. Newport Beach or Laguna Beach are closer to Corollary headquarters, but White calls their real estate prices "prohibitive."

Jim Gula, now marketing manager for Western Digital at its Irvine headquarters, has known White for 10 years. He was part of the NuMachine group. People from the group still socialize. He confirms that White's personal values are the same as they were before Corollary's success.

"Making huge amounts of money is not his big goal," Gula explains, adding that White's motivations lie in other directions –not only toward technology, but toward people. "It's a rare engineer that's people-motivated. That's what's made him successful–his ability to establish relationships throughout the industry. He has a genuine concern for people, and among people who are strong technically, that's a unique skill."

It's not just people White relates to on a deeper level of concern. He also stopped eating meat back in his undergraduate days at MIT, eventually formulating the practice of not eating anything that might be smart enough to have friends, he says. This doesn't include fish, White adds, because "they don't seem that bright to me."

What's Next

White is quite content as multiprocessing's man of the hour. "I don't have to actually do any engineering or build any products," he says. "I have the duty and luxury of keeping up with what's going on in the industry." He likes to read complex technical articles on esoteric topics. He is particularly interested in the relationship between parallel processing and supercomputers, and believes the resulting technology will impact his business.

As for multiprocessing on PCs, White believes that in the near term, progress is pretty easily identified: Intel will follow the 80X86 route through the 1990s. In addition, he predicts another melding of two fields: fault-tolerant multiprocessing.

For his own future, he has every entrepreneur's fear when it comes to company growth leading to impersonal values. "I have vowed that if we get so big that we have people on golf carts in the parking lot, giving parking tickets to people who park their car sideways, that's the day I quit." □

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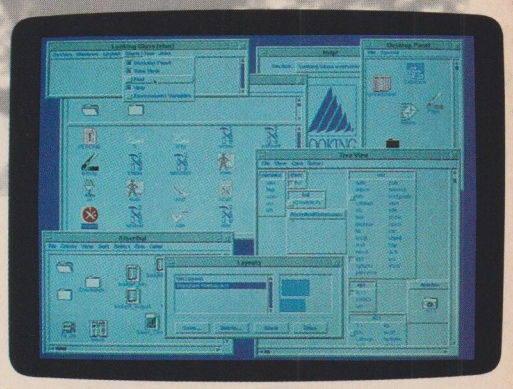

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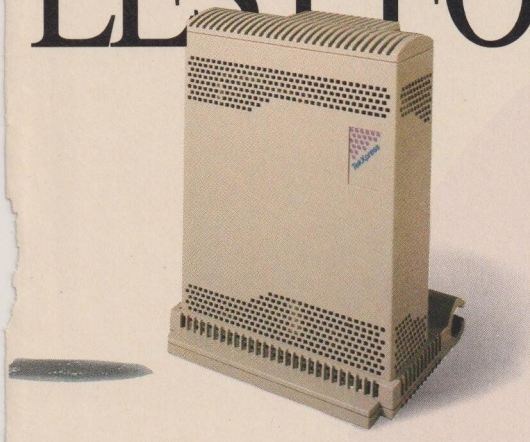

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TOP 10 *UNIX Companies*

If you read our Top 10 UNIX companies list from last year, you'll see that some familiar faces make up this year's list. In fact, they're all the same. We searched for new companies that had phenomenal growth in the UNIX market (NCR comes to mind), but no newcomer grew quite enough to merit inclusion in UNIXWORLD's annual list of the Top 10 UNIX companies.

Our Top 10 UNIX hardware and software giants continued their superiority in the UNIX arena because of their dominance in technical applications, their inroads into commercial markets, and their expansion into foreign markets. Strengths in these areas fostered continued growth, but at a slower rate than last year. Last year's Top 10 had an average growth rate of 50 percent. This year's Top 10 weren't quite as successful, at a 31 percent average growth rate.

By Gary Andrew Poole

Although the overall computer market experienced a slowdown, most companies have realized that UNIX is the fastest growing segment in the computer industry. Hewlett-Packard and Digital Equipment Corp. have had to cut employees. R&D budgets have been slashed at many companies. And high-tech stocks, once Wall Street's darlings, have been hit hard this year. An economic downturn is one cause; another is the inability for many companies to meet consumer demand, especially in "new" markets like UNIX.

Despite overall market problems and the stagnancy of some companies to enter new markets, UNIX sales have continued upward worldwide. UNIX share of systems revenues was 12 percent in 1989 and is expected to be 25 percent by 1995, according to DMR Group Inc., a research firm based in Toronto, Ontario. But profit margins could go down significantly if vendors don't develop and market UNIX on a broader scale, especially in Europe where there's buying clout and open systems is popular. Comparatively, the U.S. market, which has traditionally been more enthusiastic about proprietary systems, is in a decline, according to analysts.

UNIX growth was most significant in Europe, where many U.S. vendors sell more than 40 percent of their total systems; on the software side, database vendors are typically selling 50 percent of their software in Europe.

The most successful UNIX companies, like Sun Microsystems, are tapping the European market for all it's worth, but the most successful companies are also generating technology that takes UNIX from the lab to Fortune 1000-company desktops.

TOP 5 HARDWARE VENDORS

1. **Hewlett-Packard Co. $2.8 billion**
2. **Sun Microsystems $2.75 billion**
3. **Digital Equipment Corp. $1.6 billion**
4. **Unisys Corp. $1 billion**
5. **IBM Corp. $990 million**

TOP 5 SOFTWARE VENDORS

1. **Oracle Corp. $250 million**
2. **Informix Software, Inc. $177 million**
3. **The Santa Cruz Operation $100 million**
4. **Ingres Corp. $70 million**
5. **Interactive Systems Corp. $60 million**

TIPTOE THROUGH THE TULIPS

Most significantly, vendors have increased their UNIX product offerings across the board. Even proprietary die-hard IBM made a commitment to UNIX in 1990 with the roll-out of the RS/6000 family. "A lot of people were resisting UNIX," says Paul Cubbage, an analyst with Dataquest. "IBM has validated the market."

Yet, IBM has only tiptoed into the market. The UNIX percentage of IBM's total business stands at a slivery 2.5 percent. The real open systems leaders on the hardware side are Hewlett-Packard and Sun Microsystems; the software side gives us Oracle, Informix, and The Santa Cruz Operation.

These companies can shape the UNIX market with every move. Together, their contributions make up almost all the UNIX marketplace. But other, more general trends also shaped the market this year.

WINDOWS TO THE WORLD

The introduction of Windows 3.0 has reduced the incentive for PC users to switch to UNIX, according to Marc Schulman, vice president at UBS Securities. Market research firm International Data Corp. estimated that Windows had 14.5 percent of the operating systems market last year. It will grow to 28.7 percent in 1994, says the firm. The increased functionality of DOS-based PCs and the appeal of LAN servers have diminished the market potential for UNIX.

But Windows has also created markets for high-end PC makers like IBM and HP, says Schulman. This means Sun is in effect locking itself out of the market in the long run by positioning its products as alternatives to PCs. (Despite this claim, Sun had meteoric growth during the year, and most analysts predict its growth will continue in 1991.)

On the software side, SCO made a significant announcement at its SCO Forum90 conference. SCO, Intel, and

AT&T's UNIX System Laboratories agreed on a new baseline for standardized 386-based UNIX software. The extended standard guaranteed that existing XENIX and SCO applications will run under System V Release 4.

HOW WE TABULATED OUR RESULTS

To come up with the results for the UNIXWORLD Top 10 we asked 20 or so leading UNIX companies to provide an estimate of their revenues for the 1990 calendar year. We also called analysts for their estimates, and then averaged the figures. One software vendor–UNIX System Laboratories (USL), the AT&T subsidiary that sells System V licenses–wouldn't release financial information, and analysts felt insecure about predicting its revenues. It has been excluded from the ranking.

HARDWARE

Hewlett-Packard Co.
Palo Alto, Calif.

1990 UNIX Revenue: $2.8 billion
Change from 1989: +33%
UNIX Percentage: 17%
Number of Employees: 93,000
Chief Executive Officer: John A. Young
Head of UNIX Division: Dean O. Morton
Sources: Dataquest, Hambrecht & Quist, Hewlett-Packard, International Data Corp., ITG, Open Systems Advisor, Sierra Group

Last year, Hewlett-Packard and Sun Microsystems were tied for first place as the number-one UNIX hardware company. This year HP topped our list by 7 percent more growth than Sun in its UNIX market. Most analysts projected that HP could get a nose ahead of Sun; it did so by cutting about 3,000 employees. Sun Microsystems, many analysts say, is in the driver's seat, prepared to pass HP in UNIX revenue in the coming year.

HP started out the year strong with its release of the 9000 line of workstations and minicomputers, but faced problems in June, when it announced the HP 9000 Series 400 family of five workstations running HP-UX and Domain OS. The line has been based on Motorola's 68040 microprocessor. Unfortunately, Motorola's lateness in delivering the chip has left a void in HP's workstation line–one that Sun has been happy to fill.

"[HP] lost market share in the workstation market," says Bob Herwick with the investment firm of Hambrecht & Quist. "They've been investing heavily in R&D. It should pay off in the next two years." But two years might be too late, say many analysts. HP has been making a considerable amount of money on its technology of old, but it has been slow to produce products that people want in the lower-end commercial market.

Still, HP continues its dominance in scientific/engineering environments with a majority of its 9000 sales going to technical applications.

HP's strength comes in the high end of its line with 1990-released products like the UNIX server 9000 Model 645SV and the fault-tolerant 9000 model 1240. HP's growth depends on sustaining its high-end leadership and improving the workstation part of its product line. Its growth in its workstation business will be the difference between staying number one in UNIX revenue or being overtaken by Sun Microsystems.

One high point for HP this year was its ability to iron out many of the problems with the HP/Apollo merger that happened the year before. "The merger was difficult, but the worst is over," says Merrily Shinyeda, president of the Sierra Group. "HP is in a very strong position."

Sun Microsystems
Mountain View, Calif.

1990 UNIX Revenue: $2.75 billion
Change from 1989: +29%
UNIX Percentage: 100%
Number of Employees: 11,490
Chief Executive Officer: Scott McNealy
Sources: Dataquest, Hambrecht & Quist, International Data Corp., ITG, Open Systems Advisor, Sierra Group, Sun Microsystems Inc.

When a company grows as much as Sun Microsystems has in the last few years, there are bound to be problems. But in 1990 Sun's glitter didn't tarnish much. Yes, it had some difficulty penetrating commercial markets. It lost a significant round with the Open Software Foundation, when its graphical user interface–Open Look–lost out to Motif.

But Sun has established itself as the workstation company to beat. This year it also introduced the IPC, a high-end PC aimed at the ever-hard-to-please commercial sector. Convincing nontechnical managers to buy a Sun PC has been difficult, but its introduction is a reflection of a company prepared to sow the seeds in diverse markets to ensure future success.

Sun's bread-and-butter is its workstations based on the SPARC chip, and the company has swayed a great number of important software developers to write for its environment.

This year it made agreements with Lotus Development Corp., Ashton-Tate, and Mentor Graphics. Lotus shipped its 1-2-3 spreadsheet for all three Sun hardware architectures (Intel, Motorola, and SPARC). Ashton-Tate agreed to make dBase IV available on Sun systems. It was Ashton-Tate's first port to a UNIX system. Mentor Graphics agreed to port all its electronic design software to Sun's SPARC line.

Sun's continued growth will depend on its ability to make such agreements and its prowess in the commercial market, say many analysts.

"It's going to be tough for Sun to make the transition to the commercial marketplace," says Merrily Shinyeda, president of the Sierra Group. "MIS people tend to go with IBM and HP. Sun doesn't have that sort of loyalty with Fortune 1000 companies."

"Sun is making inroads into the commercial side," asserts Paul Cubbage with Dataquest. "I think their investment into this market will pay off."

Digital Equipment Corp.
Maynard, Mass.

1990 UNIX Revenue: $1.6 billion
Change from 1989: +23%
UNIX Percentage: 15%
Number of Employees: 124,000
Chief Executive Officer: Kenneth Olsen
Head of UNIX Division: Domenic LaCava, vice president UNIX-based software and systems

continued

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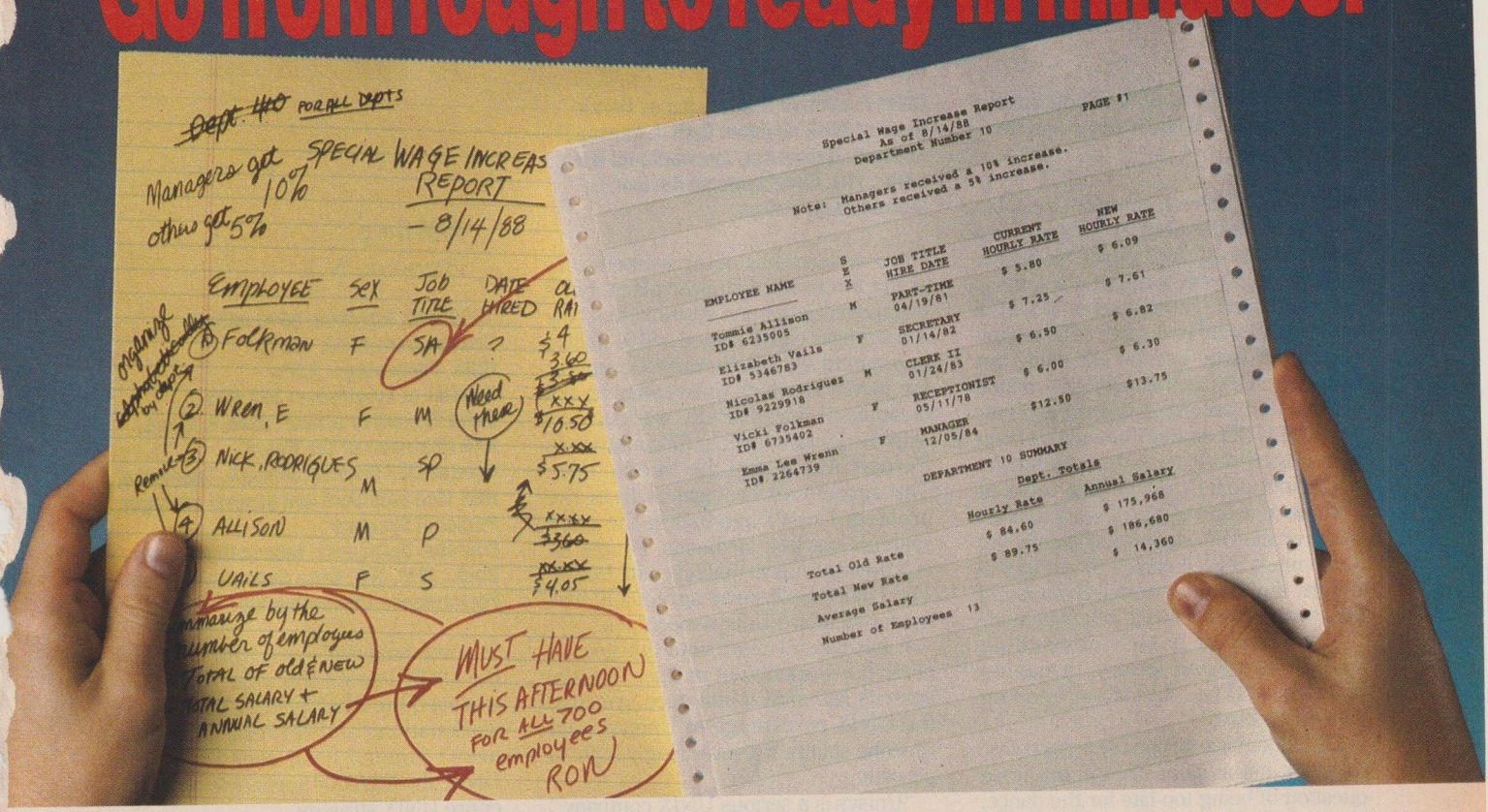

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Sources: Dataquest, DEC, International Data Corp., ITG, Open Systems Advisor, Sierra Group

DEC's UNIX revenue grew this year, but it struggled with internal problems. Between 8,000 to 10,000 employees left the company this year through a voluntary severance plan. The reduction in DEC's work force could result in a $280 million one-time charge against earnings, but could save DEC as much as $250 million in fiscal 1991, according to some analysts.

DEC's UNIX strategy has always been convoluted as it teeters between its UNIX line and its VAX line. It introduced a whole new line of UNIX workstations this year, the DECstation 5000 family, yet it continues its reluctance to put its full weight into open systems. Because of this, say analysts, DEC is falling behind.

"Its customer base is demanding UNIX," says Brian Jeffery, managing director at ITG. "And it's proposing something else."

DEC does have an open systems policy, its workstation sales are up, but it's a question of being too late for the dance. By resting on the laurels of its popular minicomputer line, DEC watched as Sun and HP stole customers away to their workstations. The DECstation 5000 has moved DEC into the realm of open systems competition once again, but its tardiness has cost them. Workstation sales grew at 35 percent this year to $8.1 billion, and mini sales were flat. DEC lost customer loyalty by its late entry.

Many analysts attribute DEC's problems to its internal structure. "DEC's products are solid," says Merrily Shinyeda, president of the Sierra Group, but she says DEC's "infrastructure is very heavy," which has cost them the quickness to capitalize on new markets.

DEC's ability to catch up with other workstation vendors will be the deciding factor of its open systems success, say analysts.

Unisys Corp.

Blue Bell, Pa.

1990 UNIX Revenue: $1 billion
Change from 1989: +25%
UNIX Percentage: 20%
Number of Employees: 75,000
Chief Executive Officer: James Unruh
Head of UNIX division: Cyril J. Yansouni
Sources: Dataquest, International Data Corp., ITG, Open Systems Advisor, Sierra Group, Unisys

Open systems has never seemed to be at the forefront of Unisys' plans, but it has moved into open systems this year at a stronger clip. It signed a $150 million agreement with Solbourne Computer Inc. in May, in which Unisys would resell Solbourne's line of SPARC workstations with the Unisys label in 67 countries in Europe, Africa, and the Middle East. The agreement brought to light the problem Unisys has had in the open systems market: tardiness. People aren't buying Unisys machines in droves. The Unisys-Solbourne agreement was not for standard Unisys machines.

It has taken Unisys until this year to enter the workstation market. Yet, despite its late arrival into open systems, the UNIX percentage of Unisys' total revenue stands at a surprisingly high 20 percent.

"Unisys is a serious UNIX company," says Paul Cubbage, an analyst with Dataquest, "but they don't want to slaughter the cash cow (its proprietary systems)."

Many analysts say that Unisys must increase its open systems growth if it wants to become a stronger industry player, but its initial reluctance has hurt it because it hasn't established a large base of customers.

One move to sway customers came this year when Unisys introduced its first family of commercial UNIX workstations–the U6000/WS systems–which could propel Unisys into becoming a larger player, according to Nina Lytton with the *Open Systems Advisor*. The U6000/WS systems, introduced in May, run UNIX and MS-DOS in a windowed environment, and were created for the "emerging commercial workstation market," according to a Unisys spokesperson.

But Unisys has the same problem DEC had by entering the workstation market so late. HP and Sun continue to rule the roost. Many analysts haven't heard of the U6000/WS, nor have many users. Unisys has a definite image problem as a laggard, and it hasn't produced a substantial product that has changed that perception, according to analysts.

Says one analyst, "It has such a confusing product line that it's scary."

IBM Corp.

Armonk, N.Y.

1990 UNIX Revenue: $990 million
Change from 1989: +32%
UNIX Percentage: 2.5%
Number of Employees: 383,000
Chief Executive Officer: John F. Akers, IBM Chairman of the Board
Head of UNIX Division: James A. Cannavino, IBM vice president and general manager, Personal Systems
Sources: Dataquest, International Data Corp., IBM, ITG, Open Systems Advisor, Performance Computing Inc.

In some analysts' eyes, IBM validated the UNIX market this year when it introduced the RISC System/6000 line of workstations and servers. Still, IBM hasn't jumped head over heels into UNIX: the RS/6000 appears to be IBM's entire UNIX strategy.

It tried to break into the UNIX workstation market four years ago with RT PC, which failed to capture the hearts and pocketbooks of many consumers. In 1989 it only held 1.8 percent of the $6.1 billion worldwide workstation market. In 1990, IBM's UNIX percentage of its total revenue is still at a paltry 2.5 percent, but we *are* talking Big Blue here. IBM has made a considerable amount of money in UNIX this year despite its low UNIX percentage because of the popularity of the RS/6000. Software vendors have also been enthusiastic. When they got a chance to port software for a new IBM machine, they did it in droves for the RS/6000.

While UNIX continues to be a miniscule part of its business, that part is growing. In fact, UNIX has made such inroads into the commercial market that some traditional IBM customers have bolted. K Mart Corp., for example, has begun replacing IBM minicomputers in 2,500 of its stores with UNIX-based computers from Unisys.

Despite this entrance into the UNIX market, IBM continues to be essentially proprietary through and through. IBM, many analysts warn, needs to move into UNIX at a faster pace or it will be left further behind. Its growth into open systems, says Brian Jeffery of ITG, has been only "incremental."

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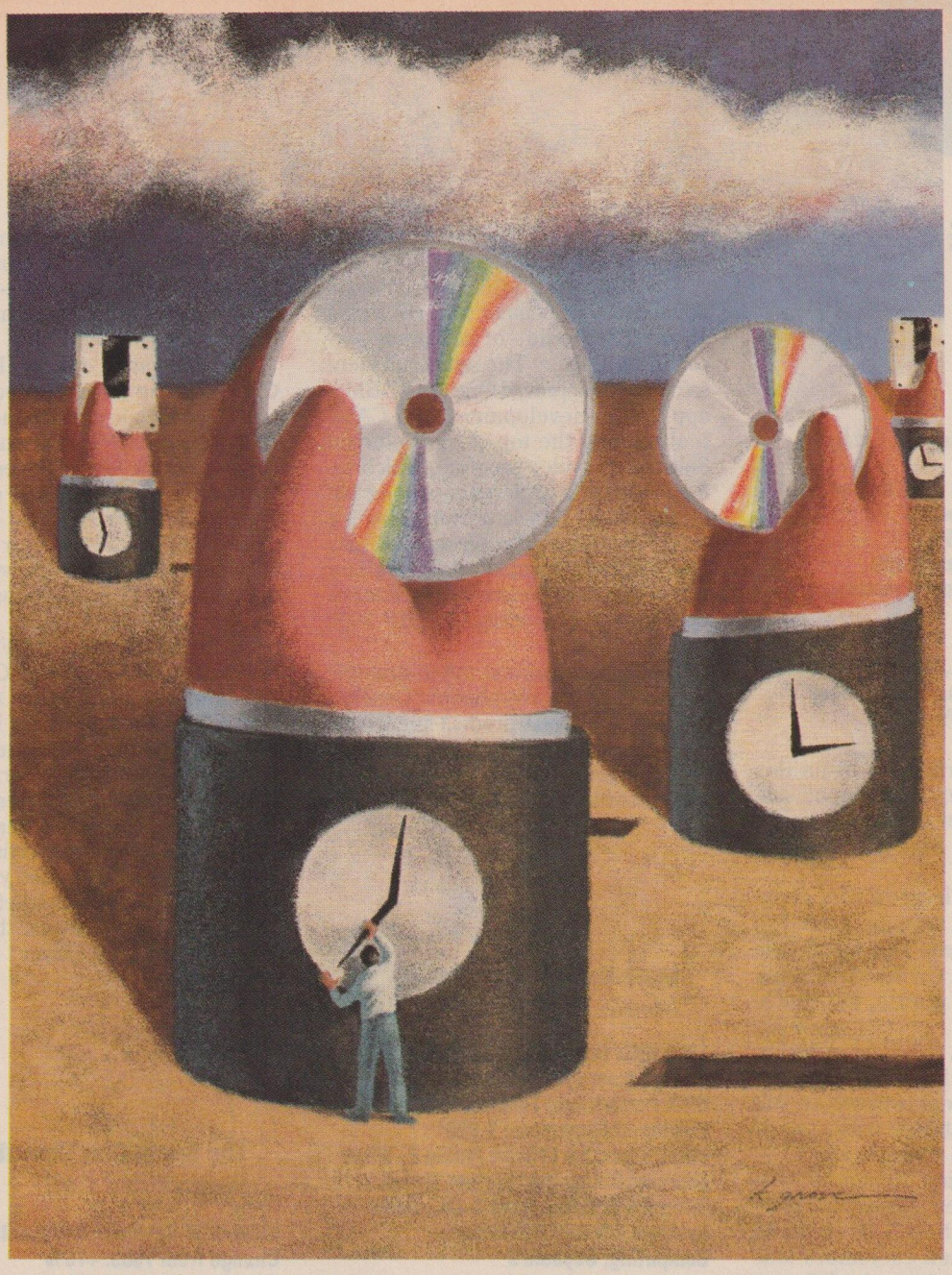

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CIRCLE NO. 99 ON INQUIRY CARD

TOP 10
UNIX Companies

SOFTWARE

1

Oracle Corp.
Redwood Shores, Calif.

1990 UNIX Revenue: $250 million
Change from 1989: +25%
UNIX Percentage: 35%
Number of employees: 7,000
Chief Executive Officer: Lawrence J. Ellison
Sources: Dataquest, Gartner Group, ITG, Needham & Co., Open Systems Advisor, Oracle Corp., Performance Computing, Seybold's

Oracle came in first place again this year as UNIXWORLD's number-one software company, but in many people's eyes Oracle didn't have a lot to cheer about.

Last year Oracle grew like gangbusters. Its UNIX revenue grew at a whopping 150 percent. This year Oracle grew at 25 percent. On the surface that seems like decent growth, but Oracle expected more.

Rich Finkelstein, president of Performance Computing Inc., says one of the reasons for the slow growth was a result of the relational database management system (RDBMS) market, which he says is in "contraction" right now. "Oracle's promises haven't turned into reality," he says. "It hasn't lived up to expectations. When customers lose once, they don't want to go back."

Oracle introduced a number of UNIX-related products in 1990, including SQL*Forms, SQL*Menu, SQL*Plus, SQL*ReportWriter, PL/SQL, Pro*C, SQL*Net, CASE development tools, Oracle*Mail, and Oracle Financials on more than 40 UNIX platforms and RDBMSs. It signed a deal with Sony in April to port its RDBMS and application development tools to Sony's News family of UNIX workstations. Despite deals like this, Oracle had problems overall.

Oracle had a slow fourth quarter, along with problematic internal accounting practices, which put a black eye on the company and sent its stock tumbling. In August Oracle disclosed that revenue posted in the second and third quarters of fiscal 1990 would be shifted to the fourth quarter. After the announcement the stock went down to a 52-week low of $10.88.

The following month Oracle announced an agreement with HP aimed at turning the tide of bad press surrounding Oracle. The announcement said that HP approved Oracle's RDBMS, application development, and CASE tools among the top of its Preferred Solution Provider program, which reflects a strong preference among HP customers for Oracle software running on HP platforms. The agreememt also said that Oracle would establish a new business unit to ensure tighter integration of Oracle products for HP 3000 systems.

This agreement and other strategic moves couldn't overshadow Oracle's problems. Its UNIX product line was its most popular line, but other financial turbulence inside the company hurt this and overall growth.

2

Informix Software, Inc.
Menlo Park, Calif.

1990 UNIX Revenue: $177 million
Change from 1989: +77%
UNIX Percentage: 74%
Number of Employees: 1,200
Chief Executive Officer: Phillip E. White
Sources: Dataquest, Gartner Group, Informix, ITG, Needham & Co., Open Systems Advisor, Performance Computing, Seybold's

1990 was a great year for Informix. The company's UNIX revenues grew by 77 percent from the previous year and new products refreshed the product line.

Informix introduced a number of new UNIX-related products in 1990, including Informix-OnLine, Informix-Star, Informix-QuickStep, and Wingz PC. Most significantly, Informix introduced Wingz–Informix's graphical spreadsheet–in mid-1990 for graphical user interfaces Motif, Open Look, and Open Desktop. Informix also introduced its Wingz-DataLink interface, which lets users import data into Wingz from an Informix database residing on a back-end server.

"Its application development tools are very strong," says Elliot Prince, vice president of Needham & Co., a stock investment firm. "Informix-Online, Informix-Star, and Informix-QuickStep are all important development tools. It's a strong company."

Still, Howard Graham, Informix's CFO, says he is concerned with the overall economic climate and its effect on the company. "Half of our business comes from the United States," he says. "If there's a broad-based slowdown here, I'll be worried about our profitability. 1990 was a good year for us. I'm very pleased with the growth in revenue. Our UNIX market continues to prosper."

On the down side, Rich Finkelstein, president of Performance Computing Inc., a marketing/analyst firm, says Informix needs to strive for better support. "Invariably their customers say, 'Product good, support poor,'" he says. "Like all software companies, Informix needs to put more into technology and support and less into advertising."

Overall, 1990 was a good year to take a bite out of Oracle's market share, according to some analysts. "Informix is becoming the main player," says Brian Jeffery with ITG.

3

The Santa Cruz Operation
Santa Cruz, Calif.

1990 UNIX Revenue: $100 million
Change from 1989: +18%
UNIX Percentage: 100%
Number of Employees: 1,200
Chief Executive Officer: Larry Michels
Sources: Dataquest, ITG, Open Systems Advisor, Performance Computing, SCO, Seybold's

The Santa Cruz Operation (SCO) made its major announcement this year at SCO Forum90 in August. SCO, Intel, and AT&T's UNIX System Laboratories agreed on a new baseline for standardized 386 UNIX software. The new standard extended Intel's 386 binary-compatible standard (iBCS) to include compatibility with XENIX 386, SCO UNIX System V/386, and Open Desktop. The extended standard, called iBCS Edition 2, guaranteed that existing XENIX and SCO UNIX applications will run under System V Release 4.

continued

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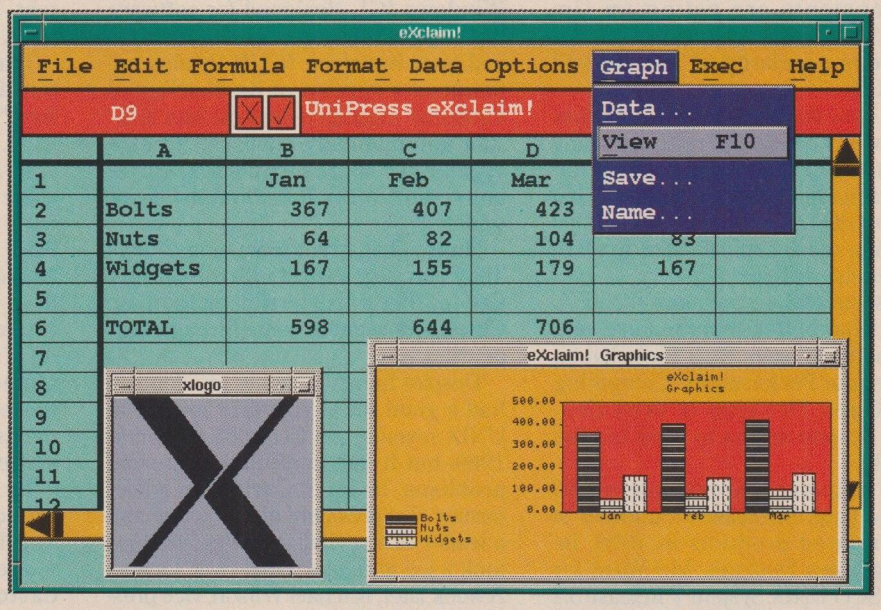

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"SCO UNIX is taking off nicely," says Brian Jeffery with ITG. Jeffery says the move toward 386/486-based machines will help XENIX. "SCO's future looks bright if not spectacular," he adds.

In the short term, SCO is doing a "terrific" job of putting technology into the marketplace, says Paul Cubbage of Dataquest, but its "platter of developments are eating up [income]." Cubbage agrees that the rising tide in popularity of 386/486 will help SCO.

SCO has calculated well and continues to grow at a consistent rate, say many analysts. "SCO has 80 percent of the low-end market," says consultant Nina Lytton of the *Open Systems Advisor.* "It's becoming more sophisticated in all of its other channels, too."

But some analysts are more skeptical. "OS/2 is far better, more mature, and more settled," says Rich Finkelstein, president of Performance Computing Inc. "Open Desktop is very confused. No one seems to want to take control."

SCO had a steady growth rate in 1990 of 18 percent. It released a number of UNIX-related products in 1990, including Open Desktop, MS Word for UNIX, SCO UNIX System V Release 3.2 Version 2.0, and MPX (multiprocessing extension).

Ingres Corp.

Alameda, Calif.

1990 UNIX Revenue: $70 million
Change from 1989: +27%
UNIX Percentage: 40%
Number of Employees: 1,200
Chief Executive Officer: Paul E. Newton
Head of UNIX Division: Mitch Bishop, director of open systems
Sources: Dataquest, Ingres, ITG, Gartner Group, Open Systems Advisor, Seybold's

In September Ingres Corp. took a new turn in its often insecure history when ASK Computer Systems signed a $110 million deal to buy the company. The deal was one of the biggest software industry mergers in history. Ingres had been consistently losing market share to Oracle in the last few years. The deal was seen as favorable to Ingres by many analysts, but in October it was being challenged by stockholders.

The months prior to the announcement were relatively quiet for the company. It had stabilized its decline. "It's off the critical list," said Brian Jeffery with ITG at the time.

In 1990, Ingres introduced a fourth-generation language (4GL)–Ingres/Windows 4GL–designed for software developers wanting to create a graphical user interface (GUI). It also announced a version of its distributed database manager–Ingres/Star 6.3–that automatically ensures the data on multiple Ingres databases will be consistent after the databases are updated.

"Ingres has great technology," says Tony Percy, an analyst with the Gartner Group, "but it has terrible marketing. Customers seem to come through happenstance."

Despite Ingres' ongoing problems, it had a good fiscal year–$70 million in UNIX revenue, up from $55 million in 1989–but it has continuous internal problems. In June, Chris Greendale, former vice president of marketing and a leader of a revitalized sales strategy, took a job at Ingres' chief rival, Oracle. A week later, Michael Wilson, vice president of sales, left.

If it succeeds, the ASK merger will unquestionably create turmoil at Ingres (like most mergers do), but many analysts see the merger as a good mesh. ASK was already using Ingres software to develop new products, and has long sold programs that run on HP minicomputers.

Interactive Systems Corp.

Santa Monica, Calif.

1990 UNIX Revenue: $60 million
Change from 1989: +20%
UNIX Percentage: 100%
Number of Employees: 375
Chief Executive Officer: Dennis Peck
Head of UNIX Division: Ajit Gill
Sources: Dataquest, IDC, Interactive

Interactive Systems stayed in the Top 10 UNIX companies this year, but it was with some trepidation on our side. First of all, many analysts we asked had never heard of Interactive Systems. Secondly, analysts who had heard of Interactive were reluctant to give projections. One well-regarded analyst had heard rumors that the privately held Interactive had lost money this year. Others feigned ignorance. When we asked representatives at Interactive for financial figures they were reluctant, but presented them at the 11th hour.

Interactive is a low-profile company, but "it's starting to bubble to the surface," says Dennis Peck, Interactive's CEO.

In 1990 Interactive became a larger voice in the open systems community with a series of announcements. In April 1990, Interactive introduced the Norton Utilities for System V, a database recovery application from Peter Norton Computing Inc. that runs on AT&T's System V. The product was aimed at DOS users preparing to move to UNIX and users of heterogeneous networks. Sun and HP signed agreements to support the product.

In August, Interactive–whose direct competitor is SCO– joined USL and Intel to collaborate on the extended binary compatibility specifications (iBCS Edition 2). The purpose is to allow application developers to create a single version of their applications that will run on all 386/486 systems conforming to specifications. It also announced an agreement with Sun Microsystems to port SunOS to SPARC-based platforms from four UNIX hardware vendors–KFW Inc., Solarix Systems, TriGem Computer Corp., and Twinhead Corp. Later that month, Interactive announced it would ship Novell Portable Netware for 386/486 computers running Interactive UNIX, with the aim of making UNIX PCs the internetworking gateway of choice for LANs and WANs.

Interactive has started to move away from its hermit-like existence, according to the marketing-oriented Dennis Peck, CEO of Interactive, who joined the company this year. "Interactive has been a behind-the-scenes company in the past, but we're becoming much more marketing-oriented," he says.

Rikki Kirzner with Dataquest concurs. "It's a nice, steady, middle-of-the-road company that has made some attractive moves this year," she says.

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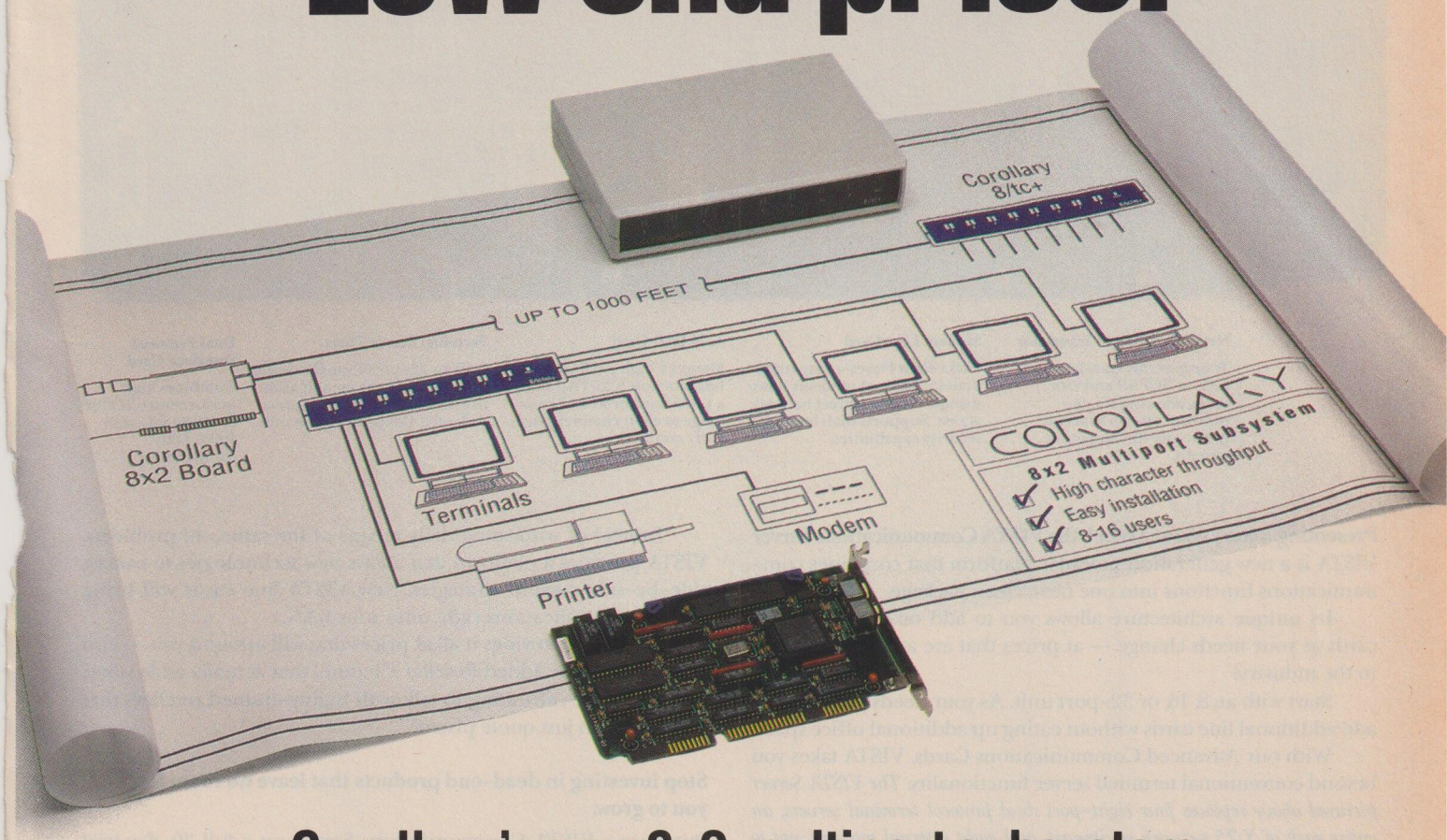

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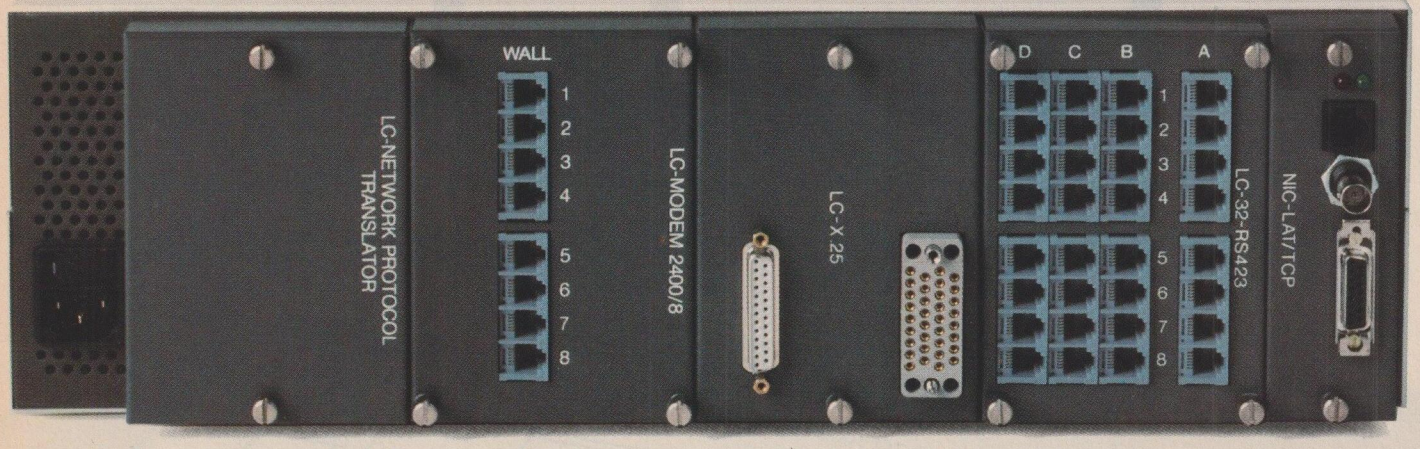

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LUIS DELGADO

Leonard Liu, president of Acer Inc. and chairman and CEO of Acer America, hopes to pump new life into Altos' faltering VAR channels in his effort to reach the billion-dollar mark in revenues.

Acer hopes Altos will push it to the $1 billion mark. Will Altos turn out to be a milestone or a millstone?

BY GARY ANDREW POOLE

The Acer Group bought Altos Computer Systems for $94 million last summer, mostly to cash in on Altos' 1,500 worldwide value-added resellers (VARs). Being the largest personal computer maker in Taiwan wasn't enough. It also wanted to get into UNIX, and Altos' 11 years of experience as a UNIX multiuser hardware vendor was too good to pass up. Or was it?

The merger could be a boon to both companies if Acer can keep the sales channels happy. But when the sale took place, the VARs were already leaving Altos. And the exodus is continuing, according to analysts.

"Altos' American distribution channels have eroded quite a bit in the past year," says Judith Hurwitz with Patricia Seybold's Office Computing Group. "Its [Altos'] European channels are still strong. That's why Acer wanted Altos, but they must be careful not to lose those channels."

Analysts warn that Acer must act quickly to keep the distribution channels alive. Otherwise, the $94 million might have been a costly investment for Acer, a company trying to reach the billion-dollar mark. Stakes are already high, because most analysts agree the PC market has reached its plateau.

Altos, now a separate business unit of Acer, still sells 80 percent of its systems

to VARs. Acer plans to pump more money into Altos to make the VARs happy. In return, Acer can use its new VAR channels to push its own products.

While Altos has had a drought of new product introductions, new products from the merged company are planned to keep VARs committed to reselling Altos products. The companies' first joint move was to introduce a single user DOS system–the Altos SX/16–which was announced in August. The SX/16 will be designed and manufactured by Acer but shipped with an Altos label, a move calculated to not scare VARs away.

A second major product announcement, planned for October, was delayed until January. Altos had planned to announce three new UNIX systems: the System 400, an entry-level multiuser system; the System/4000, a multiuser networked system for up to 64 users; and the Powerserver/5000 Model 33, a multiuser system for up to 128 users. In early October a company spokesman notified UNIXWORLD that product announcements would be delayed, but asked UNIXWORLD not to publish the names of the systems prior to January because he said "it will upset many of our VARs."

When these products are finally announced Acer hopes its investment in Altos will begin to pay off, but until then it must hope Altos' existing products can hold the fort. Altos has had a drought of new product introductions. Delays like this could hurt its penetration into the UNIX marketplace.

"The PC and UNIX are coming together on the desktop," says Leonard Liu, president of Acer Inc. and chairman and chief executive officer of Acer America Corp. (See sidebar). "We are very well positioned–with the combination of Altos' and our hardware–to move into that marketplace."

How VARs respond to the Acer-Altos joint product introductions could determine whether the Acer-Altos relationship works. Acer is in the commodity PC business. If numbers aren't generated, say analysts, restructuring and the end of Altos could be imminent. Acer has swallowed companies before.

Deja Vu All Over Again

The Altos merger is Acer's second try for the UNIX market. In November 1987 Acer bought UNIX mini maker Counterpoint Computers for its UNIX experience. Unfortunately, while Counterpoint had experience, it lacked a solid customer base. "Counterpoint never saw a profitable month," says a former Counterpoint employee. "It went through three different layoff stages. Acer's buy-out of Counterpoint was doomed from Day One."

Counterpoint began as a workstation company competing with Sun Microsystems, but failed because Counterpoint lacked manufacturing and cash resources. Its multiuser line–the System 19K multiuser, multiprocessor computer that supported 6 to 128 users–was me-too technology without any marketing reach. The company was founded in 1984 by Pauline Alker, who left as vice president of Acer America in mid-August. She refused to comment for this story.

No one will explain, on the record, why the two companies decided to merge. Some attribute it to schmoozing. The story goes that early in 1987 during a 13-hour flight to Taiwan, Ray Hou, then vice president of marketing for Counterpoint, was lucky enough to sit next to Stan Shih, the chairman and CEO of the Acer Group. Hou, who has a bachelor's degree in electrical engineering from Chiao Tung University in Taiwan, was on his way to visit friends. Somehow he came away from the flight with Counterpoint's biggest and newest customer: Acer. Hou also capitalized on Shih's interest in UNIX. Shih wanted to get into the UNIX market and Hou convinced him that buying Counterpoint would be a good solution.

Later that year Acer did just that. It bought Counterpoint for $6 million and immediately started sinking (and losing) money into the company. The first step was to release a product in a joint effort. In 1989 Acer unveiled an X networking terminal, called the Model 100, based on the 8086 chip.

"The Acer X Networking Terminal Model 100 is the first in a family of X Networking Terminals that fully integrates the X server with Ethernet to provide the 'touch and feel' of a workstation, for the price of an ordinary terminal," gushed the press announcement

Diary of a Merger

Counterpoint

- September 1976: PC maker Acer Inc. is founded with the name Multitech International Corp.
- June 1984: Counterpoint Computers is founded by Pauline Lo Alker and Fred Kiremidjian.
- August 1985: Counterpoint ships production units of its first product, the System 19.
- October 1986: Counterpoint ships first production units of System 19K, a UNIX-based multiuser system.

Acer

Altos

- January 1977: Altos Computer Systems is founded by David Jackson.

- June 1986: Ron Conway, vice president of worldwide sales and marketing, leaves Altos.

1976 | 1977-1983 | 1984 | 1985 | 1986

of the product. Acer started advertising the product in trade magazines. The industry waited for it to ship. And waited. And waited. Later in 1989, Acer decided to shelve the product.

"Acer chickened out," says Hurwitz of Seybold's Office Computing Group.

"They assured me it (X terminal) was a well-thought-out strategy," adds Eileen O'Brien, manager of the terminals program with International Data Corp. "I said, 'You gotta be kidding me!'"

This was a time when everyone was basing their platforms on the 68000 chip, she says. The market wasn't there. Acer had miscalculated and Network Computing Devices Inc. (NCD) stole the market.

Acer's Liu is the person responsible for stopping the X terminal line, which ended Counterpoint's existence. He stopped it as soon as he joined the company last year. He saw the writing on the wall. He knew the market wouldn't accept it. He believes the new UNIX strategy of acquiring Altos is a much more airtight move.

"I'll turn Altos around," he says firmly.

Altos Drowns...Can It be Revived?

The Acer-Altos merger really started two years ago when Altos began its financial descent. Altos' VARs were not buying its products. In June 1988 Altos employees realized that they'd suffered their first bad financial quarter. The UNIX-based multiuser hardware company that had made the *Inc.* "Top 100 Fastest Growing Companies" four years earlier was in a decline. Morale dropped. David Jackson, the founder of Altos, started to berate employees. "He would come into your office, re-arrange your agenda, and then you wouldn't see him for another few months," recalls one former employee. "He was very disrupting, to say the least."

Jackson's alleged ill temper was the least of the San Jose, Calif.-based Altos' problems. It had other problems similar to Counterpoint's. Its product line had become stagnant, it was unsuccessful in selling to original equipment manufacturers (OEMs), and it couldn't seem to pull out of its downhill swoop. The next quarter was a disaster. And the next. Budgets were slashed. No one at Altos could figure out the problem. Like a hitter in a slump, everyone was trying too hard. Mid-level managers were leaving in droves. Nineteen directors and vice presidents left in a six-month period, according to numerous sources.

Like a hitter in a slump, Altos was trying too hard. Managers left in droves, and 19 directors and vice presidents left in a six-month period.

Jackson had to act. After 42 quarters of growth he had a drowning company on his hands. He decided to bring Ron Conway to Altos. More accurately, he was bringing Conway back to Altos. Conway, the affable man with the boyish haircut and sales-driven attitude, had left Altos in 1986 to work as a consultant. He had helped get the company off the ground in 1979 as the vice president of U.S. sales and marketing and later as vice president of worldwide sales and marketing. At Altos he had helped guide the company to its glory back in the good old days. Now he had to make it work again.

But even the well-liked Conway couldn't restore the past glory. He had to develop a new management team from scratch. Altos' technology–Series 1000 UNIX-based multiuser (2 to 24 users) systems–wasn't in demand. Although quantitative statistics couldn't be obtained, many VARs were getting nervous and bowing out, according to analysts. And VARs are the lifeblood of companies like Altos. The whole Altos foundation had been set up to sell to the VAR channel. "As a small company, we realized early on that a company our size couldn't afford a direct sales force," says the 39-year-old Conway, who is now Altos' president. "The cost of sales was going up and the cost of computing was going down."

The structure of Altos was built on its VARs, who buy Altos' hardware,

1987

- September 1987: Multitech company name changed to Acer.
- November 1987: Counterpoint merges with Acer.

1988

- July 1988: Counterpoint Computers changes its name to Acer Counterpoint Inc.
- October 1988: Acer Counterpoint announces the Acer X Networking Terminal Model 100.
- June 1988: Altos suffers its first quarterly loss.
- November 1988: Ron Conway rejoins Altos.

1989

- April 1989: Leonard Liu joins Acer as president of Acer Inc. and as chairman and CEO of Acer America Corp.
- Summer 1989: The Acer X Networking Terminal Model 100 is shelved.

1990

- July 1990: Acer and Altos announce merger. Altos founder Jackson is bought out.
- August 1990: Altos announces first new product--the SX16, a single-user DOS system--since the merger.
- August 1990: Pauline Lo Alker resigns.
- October 1990: Altos delays the announcement of three new multi-user products: the System 400, the System/4000, and the Powerserver/5000 Model 33.

1991

- January 1991: Altos scheduled to announce the System/4000, the System 400, and the Powerserver/5000 Model 33.

bundle it with software or other features, and resell the "new" product as a package. Those VARs were unhappy. Desperate, Conway decided to hit the streets and drum up support for Altos with face-to-face meetings with the VARs. Conway and his newly hired vice president of U.S. sales and marketing, Ted Drysdale (now executive vice president of sales and marketing), crisscrossed the country. They came back humbled. The VARs had complained vehemently. Conway and Drysdale had reams of paper filled with more than 200 complaints against Altos. The VARs wanted change or Altos was, quite frankly, *kaput.*

"Overall, we just weren't being responsive to our customers," cringes the sales-oriented Conway.

The major complaints were service-oriented. The biggest problem was that Altos wasn't being responsive on its customer support hot lines. Also at issue was that VARs weren't allowed to buy spare parts directly from Altos. Instead, the VARs resorted to a sub-distribution network.

But Altos started addressing each complaint, starting from the first one and working its way down. "By the time we got to number 50 on the list the VARs were saying, 'Hey, here's a management team that cares about us,'" recalls Conway.

Despite this late effort, Altos lost a record $15 million in operating income that year–a huge loss in Altos' terms, whose net sales in 1988 were $175 million. (Last year it was at a still-troubling $5 million net loss for the fiscal year.)

Many former employees say the losses occurred because the VARs were still nervous. "There's a real credibility drop when VARs see a different person every month," says one former high-ranking official at Altos. "When they see the second- and third-string people, who have had their heads under the desk as the ---'s been flying, then you're not going to get sales. [VARs] just don't see the leadership there."

Conway realized Altos' problems went beyond just the company itself. The minicomputer market was in a decline. He told Jackson that by 1995 there would be no successful companies in the computer industry with less than $1 billion a year in sales. Jackson, the never-say-die entrepreneur, fought the idea. But finally after much deliberation, he realized Altos was going down–and going down fast. He agreed to let Conway, with the help of the investment firm of Morgan Stanley, find a large company to buy it out.

Many companies came calling. The most cash-rich and enthusiastic suitor, The Acer Group–the largest personal computer maker in Taiwan–finally bought the company last summer for $8.35 a share. On July 4, in an all-day meeting, the papers were signed. Acer had entered the UNIX market again; Altos was saved.

The transaction was valued at $94 million. Close to half of the amount went to Dave Jackson and his ex-wife Sue. (Jackson received 25 percent and his ex-wife received 15 percent.) The other 60 percent was owned by other investors and institutions, 95 percent of which tendered their shares.

Acer could realize an additional $200 million in revenue from its Altos buy-out to bring it closer to its goal of billion-dollar status.

Can Acer Pull it Off?

Acer, a $700 million company, wants to be a billion-dollar company. Altos could provide another $200 million in revenue and get them closer to the top.

The man who vows to push Acer forward is the aforementioned Leonard Liu. Liu came from IBM where he led the RT PC team that eventually developed the RS/6000, but he admits he's "not an expert in the UNIX *business* yet." His lack of UNIX business experience could be a significant hindrance to keeping the VAR channel happy. "We must get together with the right people in the channel to deliver the goods to the end users," he says. "That's going to be the critical factor for success. You'll see if we've been successful in a couple of years."

But analysts say two years is too late. In the short term, say analysts, it's doubtful that Altos could pull Acer down financially because Acer is so cash-rich. Also, the two businesses won't be combined. Under the terms of the buy-out, Altos will operate as a separate unit of Acer, maintaining its own corporate name and products.

The Acer-Altos merger has many stumbling blocks, but in some ways it could work, says Robert Kidd, an analyst with Dataquest. He says their products "converge well." In other words, Acer's low-end products don't compete with Altos' high-end products.

Will this merger be successful? If Acer has learned from its prior UNIX experience, it can help Altos become profitable. A solid product line from PCs to minis could revive VARs' interest in Altos. If not, Altos could pull Acer down, leaving it short of its goal and without a UNIX strategy once again. Altos is tired of financially bad quarters; Acer doesn't want to see one. □

Leonard Liu, Mr. Efficiency

When you talk with Leonard Liu, you think *efficiency.* He answers your questions concisely and accurately. His nondescript office–decorated with pale-colored art–is like a pair of Hush Puppies: useful, but not too exciting. He wears a starched white shirt with a nondescript tie. When he shakes your hand, he pumps twice. It's a firm handshake. An efficient handshake.

No one would call Leonard Liu a barrel of laughs. His friends gave him a framed list of his attributes that now hangs on his office wall. It espouses his penchant for sack lunches and working long days. "A 16-hour work day?," he says. "That's not a long day for me." When do you sleep? "Well," he says dryly, and then explodes with laughter: "You've *got* to sleep!"

Liu, who says he swims and plays tennis occasionally, doesn't have time for too many acts of leisure. Besides being the president of Acer Inc. in Taipei, Taiwan, and chairman and chief executive officer of Acer America Corp., he's also trying to make sure the Acer buy-out of Altos works. But it isn't easy when you spend two weeks in Taiwan and two weeks in the United States every month. Liu, 48, shrugs it off. "When you're running an international business you have to travel," says Liu, who lives with his parents when he's in Taiwan. Liu's father is chairman of the board for Ford Motor Co. in Taiwan.

Liu, who holds a Ph.D. in computer science from Princeton University, feels confident about the Acer-Altos deal.

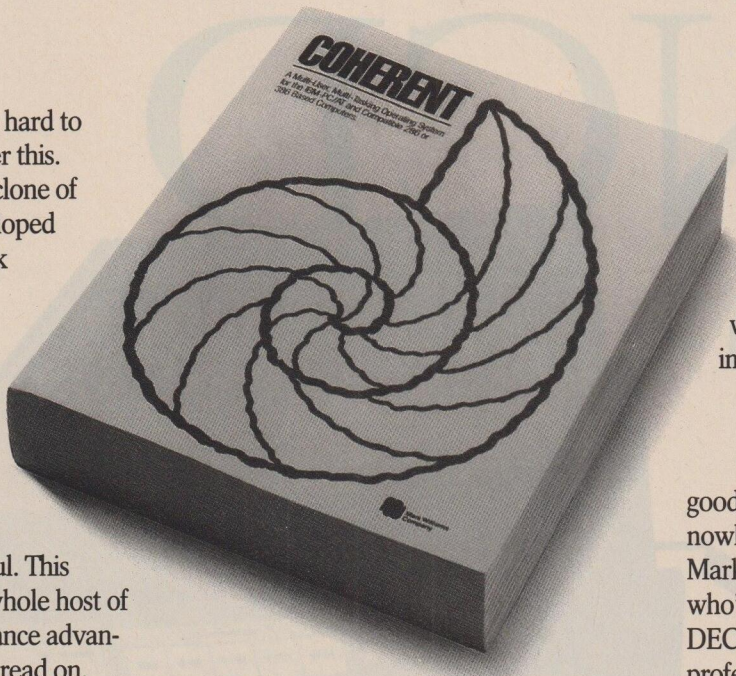
"My interest in Altos stems from my interest in the UNIX world," he says. "UNIX is commercially accepted now; it's no longer a toy." Altos is Acer's "starting point in the UNIX business," he says.

Acer will give Altos a low end for its product line. Liu adds that Acer can help Altos with manufacturing, too. "We produce a PC every 15 seconds," he says, sitting forward. "Acer knows how to produce products."

Efficient, to the end.

—*G.A.P.*

Everything You Ever Wanted In UNIX. And Less. $99.95.*



OK. We know it's hard to believe. So just consider this. Coherent™ is a virtual clone of UNIX. But it was developed independently by Mark Williams Company. Which means we don't pay hundreds of dollars per copy in licensing fees.

What's more, Coherent embodies the original tenet of UNIX: small is beautiful. This simple fact leads to a whole host of both cost and performance advantages for Coherent. So read on, because there's a lot more to Coherent than its price.

SMALLER, FASTER...BETTER.

Everybody appreciates a good deal. But what is it that makes small so great?

For one thing, Coherent gives you UNIX capabilities on a machine you can actually afford. Requiring only 10 megabytes of disk space,

LESS IS MORE!	Coherent For the IBM-PC/AT and compatible 286 or 386 based machines.	Santa Cruz Operation's XENIX 286, Version 2.3.2
No. of Manuals	1	8
No. of Disks	4	21
Kernel Size	64K	198K
Install Time	20-30 min.	3-4 hours
Suggested Disk Space	10 meg	30 meg
Min. Memory Required	640K	1-2 meg
Performance*	38.7 sec	100.3 sec
Price	$99.95	$1495.00

*Byte Execl benchmark, 1000 iterations on 20 MHZ 386.
Hardware requirements: 1.2 meg 5¼" or 1.4 meg 3½" floppy, and hard disk. SCSI device driver available soon. Does not run on Microchannel machines.

Coherent can reside with DOS. So you can keep all your DOS applications and move up to Coherent. You can also have it running faster, learn it faster and get faster overall performance. All because Coherent is small. Sounds beautiful, doesn't it?

But small wouldn't be so great if it didn't do the job it was meant to do.

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And with UUCP, the UNIX to UNIX Communication Program that connects you to a world-wide network of free software, news and millions of users. All for the cost of a phone call.

We could go on, but stop we must to get in a few more very important points.

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Yes, we know $99.95 may still be hard to believe. But we've made it fool-proof to find out for yourself. With a 60-day money-back no-hassles guarantee.

You have to be more than just a little curious about Coherent by now. So why not just do it? Pick up that phone and order today.

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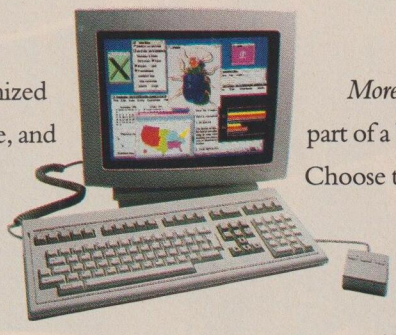

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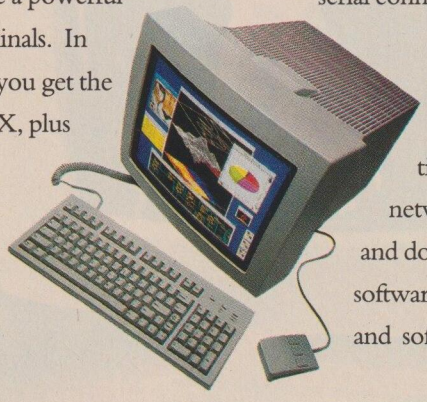

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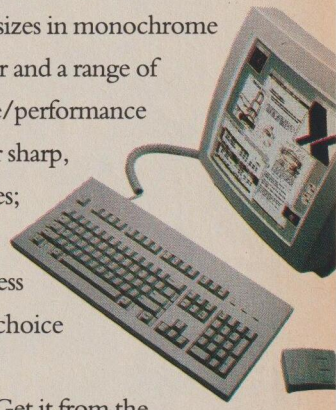

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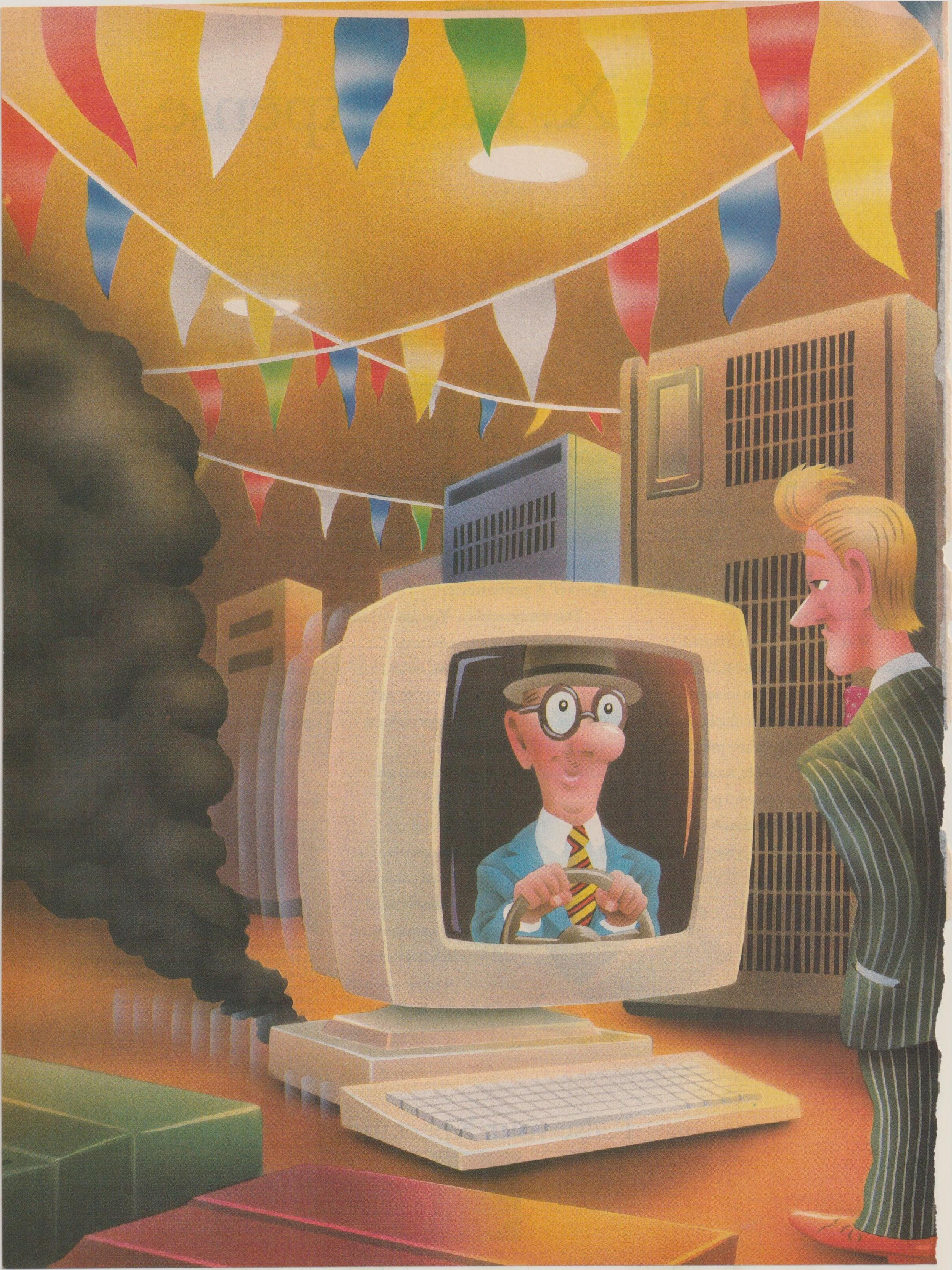

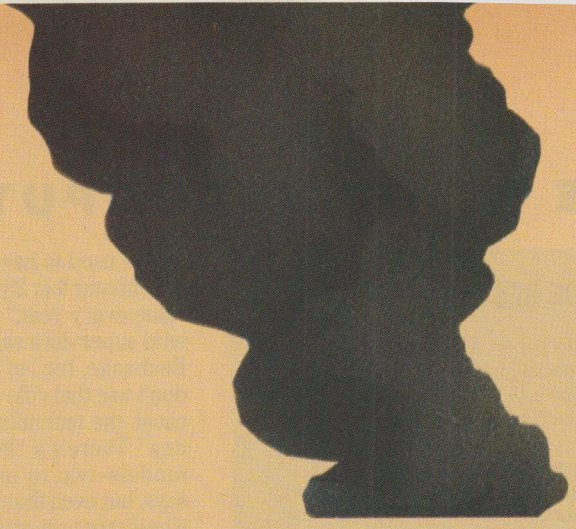

GETTING RID OF OLD COMPUTERS

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Ancient minicomputer,Lo mips, Hard Disk (Works!) Best offer or free to good home 555-8649

'76 NCR Mainframe
The pride of Dayton can run

It's finally happened: Your old minicomputer is headed out the door. Whether it's being replaced by a newer model or dumped in favor of a network of workstations, you now have hundreds of pounds of mini that you have no use for.

But now, where exactly does that mini go? Getting rid of a late-model computer isn't quite as simple as unloading your used Chevy–though some of your options are remarkably similar. Like a used car, your mini has lost value–but if it still runs and someone else wants it, it doesn't have to end up in the junkyard. With a little work and some horse trading, you may be able to turn your old beater into cash, a tax write-off, or other equipment that you can use.

continued

BY FRANK HAYES

ROBERT GROSSMAN

AFTERLIFE FOR OLD COMPUTERS

WHICH COMPUTERS HOLD THEIR VALUE BEST?

For this simple question, Jane McGowan, who supervises sales for Minicomputer Exchange, Inc., of Sunnyvale, Calif., has a simple answer: "None of them." McGowan says that with the increased rate of technological change, even the old rule of thumb that a minicomputer would have resale value for four years no longer applies.

Though there's a lively market for popular machines less than three years old, McGowan says that even after a few months, a computer's resale value is a small fraction of its original price. "It's not like a house or condominium that you buy and expect to increase in value," McGowan points out. (That sounds obvious, but McGowan says she periodically finds potential sellers who believed their computers *would* appreciate.)

There are rare exceptions to that rule, though. McGowan says her company owned an early Sun workstation, and contacted Sun Microsystems looking for manuals. Sun didn't have the manuals, but decided it wanted the machine as a collector's item. The vendor eventually swapped a brand-new workstation for the antique.

—F.H.

FINDING WORTH AMONG THE PIECES

Before you send your old minicomputer off to a dealer, broker, or scrapper, be sure you know exactly what you're getting rid of. It's likely that, over the time you've owned the machine, you've upgraded disk storage, memory, and other subsystems. If those subsystems can be used in your new computer or network, stripping the old clunker may be well worth the trouble.

Just as important as salvaging useful hardware is keeping track of software. The files on your disks may include licensed application software, specialized applications your staff has written, and freely available utilities–along with all your data files. Before giving away any disk system, be sure you've backed up all application and data files you want to save and wiped them off the disk system you're disposing of.

Doing a complete backup should be a routine system-maintenance task, but when you're transferring the data from an old system to a new one, take no chances. If possible, keep the old machine running until you've successfully transferred all files you need to the new computer. Things can go wrong with what should be a foolproof backup system. Though both your old and new computers may use similar tape backup systems with identical tape cartridges, they may use different formats for the tape. And even if the formats are supposed to be identical, an old tape drive may suffer from head skew, a condition that makes the tapes it writes unreadable to any tape drive but itself.

Make a few test runs to make sure your new machine can read the backup tapes from your old one, then do a complete backup–and then *test* the files to make sure they survived the transfer. If they didn't, transfer the files through a direct connection between the two machines. Take no chances–any data you lose will be gone forever.

Once you've transferred all files you want to keep, delete them and overwrite all available disk space. Whether you should erase applications or system software depends on the terms of the software licenses. Check them carefully–don't try to resell or give away software you don't own. Once you've deleted the appropriate files, fill *all* the remaining space on the disk with copies of a large existing file–a "garbage" file that contains no critical information. Filling the disk with garbage guarantees that deleted files will actually be overwritten and the data destroyed.

When that's complete, your computer is ready to head out the door.

—F.H.

From Rolls to Yugo

First, the bad news: An old minicomputer doesn't hold its value well. It may have been priced like a Rolls-Royce, but it's got a resale value like a Yugo.

How bad is it? One used-equipment dealer who handles mostly PCs says his rule of thumb for minis is simple: "If it runs on 110-volt current, give it away to the hackers. If it takes 220 volts, scrap 'em out–you'll get six cents a pound." That advice may contain more than a touch of cynicism, because PCs hold their value somewhat better than larger computers (if only because PCs cost much less to begin with).

"We used to have a rule of thumb that a computer lost 25 percent of its original value every year," says Jane McGowan, who supervises sales for Minicomputer Exchange, Inc., of Sunnyvale, Calif. "We don't use that rule anymore, though, because the technology changes faster today." There's a "lively market for later models–two to three years old," she says, but even that won't let you recoup a significant part of your investment: Once it's used, it's worth less immediately.

There are few exceptions. Among proprietary minicomputers, IBM systems have a longer life because they're so widely used. And DEC VAXes have a similar elongated life span, according to George Groat, director of sales for the Newman Group (Dexter, Mich.). Groat explains that demand for a particular VAX model bottoms out after about six years, then begins to rise again, because some customers find it easier to continue using their old machine rather than move to an entirely new system.

At least one company–the National Computer Exchange (New York, N.Y.)–publishes a "blue book" with prices for used minis. But it's not widely used as an authoritative guide because prices drop too quickly.

Computers are also like business-owned cars when it comes to taxes. In most cases, computers purchased by a company are subject to tax depreciation. Usually the resale price of the computer drops much faster than it depreciates for tax purposes, but occasionally–very rarely–you may have to pay additional taxes if the resale price is high enough.

Welcome to Honest Al's

The easiest way to determine how much your computer is worth is to contact either a broker or a used-computer dealer. Both brokers and dealers offer practical ways of selling your machine, but they operate in different ways.

Brokers don't buy used computers. Instead, they match up buyers and sellers. At one typical brokerage, it works like this: A seller lists equipment offered for sale, and the brokerage finds a buyer. Seller and buyer negotiate a price, and the buyer deposits the money in an escrow account until the computer is delivered. Then the seller pays 10 percent of the sales price (or at least $50) as a commission to the broker.

The advantage to brokers is that they never handle the equipment–they just arrange the deal, so an expert broker in

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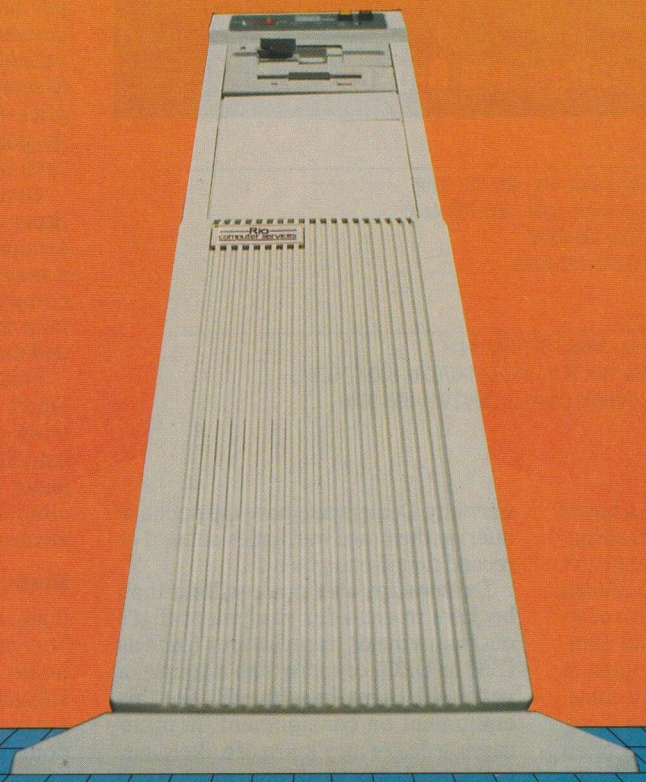

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CIRCLE NO. 117 ON INQUIRY CARD

A Partial List of Dealers and Brokers

Dealers

Computer Parts Outlet, Inc. (Delray Beach, Fla.) 407-265-1206
Minicomputer Exchange, Inc. (Sunnyvale, Calif.) 408-733-4400
More Computer (Belleville, Mich.) 313-699-0259
The Newman Group (Dexter, Mich.) 313-426-3200

Brokers

Boston Computer Exchange (Boston, Mass.) 617-542-4414
National Computer Exchange (New York, N.Y.) 212-614-0700 or 800-924-2643
West Coast Computer Exchange (Rancho Cordova, Calif.) 916-635-9340

Boston can set up a sale between a buyer and seller in Los Angeles. The disadvantage, of course, is that if the broker can't find you a buyer, you're out of luck. And if the broker can't find a buyer who's nearby, the cost of trucking your old computer cross-country may eat up most of what you make by selling your machine.

Dealers, by contrast, make their living by buying computers. While they often have buyers in mind, most dealers also keep inventories of used computers they believe they can sell. As a result, a dealer may buy your computer even if there's no buyer immediately available. On the other hand, because a dealer actually buys your computer to resell, the sales price may not be as high as it would be with a broker. Some dealers will also take certain computers on consignment, which means you won't get paid until the computer sells.

Trade-In, Anyone?

Another advantage to dealers is that they're not limited to straight cash deals. While brokers usually match up sellers with computers and buyers with cash, dealers have the option to deal–which can make your late-model mini worth more than you expected.

For example, though your old mini may not have much of a resale value, you may be able to use it as a trade-in for one or more used or reconditioned workstations, says McGowan. Like minicomputers, workstations lose much of their value in the first few months after they're sold, so a six-month-old, used workstation that's still thoroughly usable has a much lower price than it did new. In some cases, used-computer dealers will even sell new, in-the-box workstations–but usually without the manufacturer's warranty. Dealers also have the option of offering their own warranties on used or reconditioned equipment.

Dealers are also more willing than brokers to consider equipment that's not from a major manufacturer (such as IBM or DEC) or more than a couple of years old. Sometimes they'll take this equipment on consignment. In other cases, a dealer may know of a likely customer, such as a local company that still uses your model of computer, or a computer maintenance company that will use your machine for parts.

Because dealers offer far less than the original price, even for computers that are less than a year old, some sellers think they're being ripped off. Here's how to tell: Ask the dealer for the name of a broker or another dealer so you can get a second estimate. Though most dealers don't want to steer business to their competitors, they'll do it if they really believe your machine is virtually worthless. A dealer may also point you to another dealer if the first dealer doesn't handle the equipment you're selling–and the second dealer does.

Selling Your Beater for Parts

Now for the worst case scenario: Your beater is a junker. The brokers don't want it. The dealers don't want it. It may not even run anymore. What are your options?

You could check the Yellow Pages under "Computers–Service and Repair," and look for the name of your computer's manufacturer. A computer maintenance company may be willing to haul your machine away for the working parts. For the cost of a phone call, your trash may become someone else's treasure.

Next check the Yellow Pages under "Scrap Metal." Scrappers will usually pay for metal by the pound. Because computers may contain gold or other valuable metals, they're worth the trouble to scrappers, but don't expect a premium price–there's plenty of junk mixed with the gold. In a few cases, the scrapper may even be willing to pick up the machine.

Option 3: Try the want ads. A newspaper classified ad that reads "'82 VAX, lo mips, best offer" isn't likely to turn up a major buyer–but it might attract a computer enthusiast who's willing to take that large collection of hardware and manuals off your hands.

Finally, one thing that's not an option: Don't simply borrow a fork lift and truck your old machine out to the local landfill. Most landfills have restrictions about what can be dumped, and many computers contain toxic or explosive elements (such as batteries).

Back to School

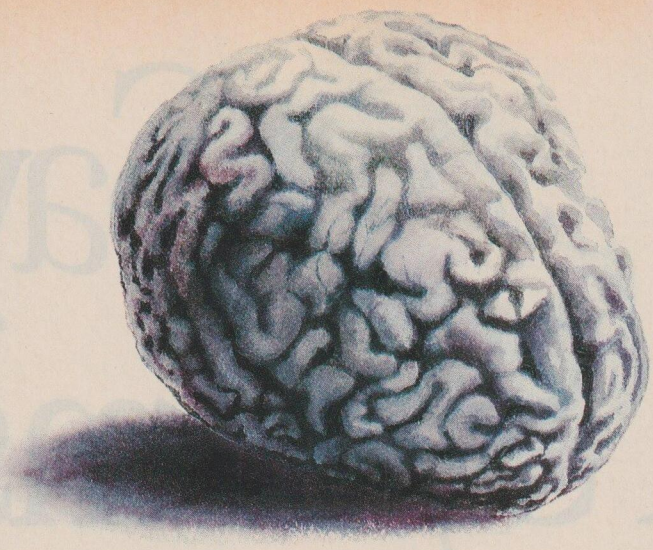
If you can't sell it, you can give it away. Your minicomputer could find a new home as a charitable donation. Local schools and not-for-profit organizations are the most likely targets for charitable donations, but you can save time by crossing the not-for-profits off your list of places to call.

Most not-for-profit organizations use computers for the same kinds of tasks needed by businesses: for handling client files or financial transactions or mailing lists. As a result, they'll get no advantage from a "free" aging minicomputer that requires custom programming and an expert on the payroll to keep it working.

But old UNIX minis can sometimes fit the needs of schools. If a local high school or junior college actually has students who are programming under UNIX, the school may be willing to take the machine off your hands. The mini will still require custom programming and a system administrator, of course, but on a "training machine," that's work the students can do themselves–in fact, that's what they need a UNIX machine for.

Though the tax write-off for your donation will be based on the actual resale value of the computer (which may be small), at least your company will get the advantage of good will for a donation to local schools.

Whether it's a junker or a gem, you're not likely to get a high resale price from your old minicomputer. But if you can trade it in on a workstation, donate it to a local school, or even convert it to spare parts, you may find there's more use than you thought left in the old machine. ■



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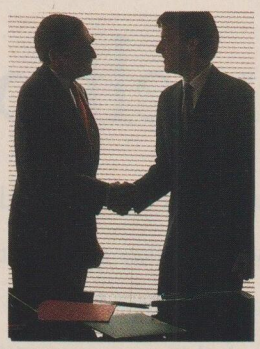
CIRCLE NO. 191 ON INQUIRY CARD

Saying A Systems Int Make



There's more to being a systems integrator than just saying so. International Data Corporation – the renowned industry research firm – has established criteria to benchmark those who claim to be systems integrators. They must:

- Create unique solutions for each contracting client.
- Carry out the project management activities of various specialists.
- Assume full systems' performance and financial responsibility for successful implementation.

While these are indeed strenuous standards, ERI exceeds them: We do more than hardware manufacturers because we can. We do more than VARs because we must. You see, ERI takes complete responsibility for project success. ERI delivers systems integration through comprehensive facilities and capabilities.

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- Extensive product inventory

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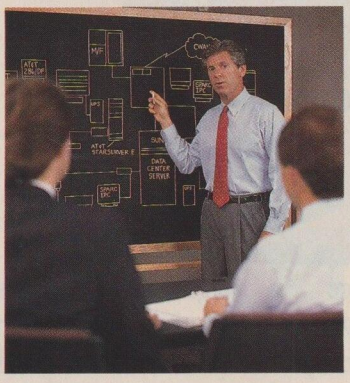

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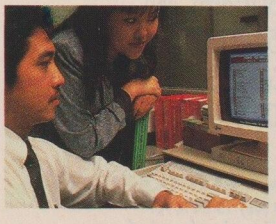

And you're never locked into today's technology because we offer a "Flexible Upgrade Policy" on every system. Plus, we offer complete financing for all ERI products and services.

As the nation's largest systems integrator for AT&T and Sun Microsystems, we ensure cross-platform interoperability in every project undertaken. Each is unique to the environment, completely managed for efficiency and timeliness, and backed by the toughest performance and financial guarantee in the industry. It takes the commitment of an entire company to consistently exceed IDC's criteria. It's the way we've chosen to answer your needs today while anticipating those you'll have tomorrow.

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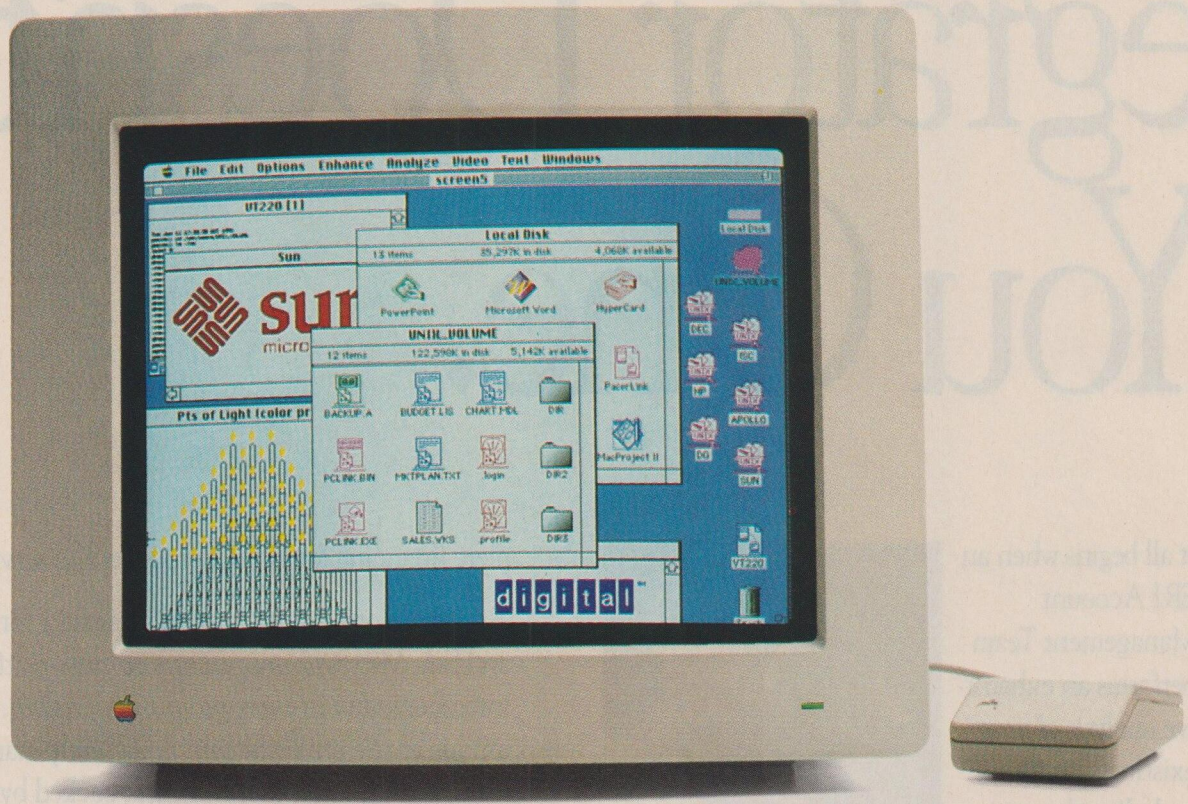

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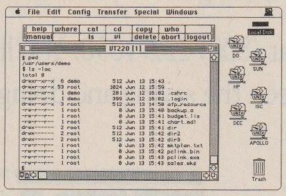

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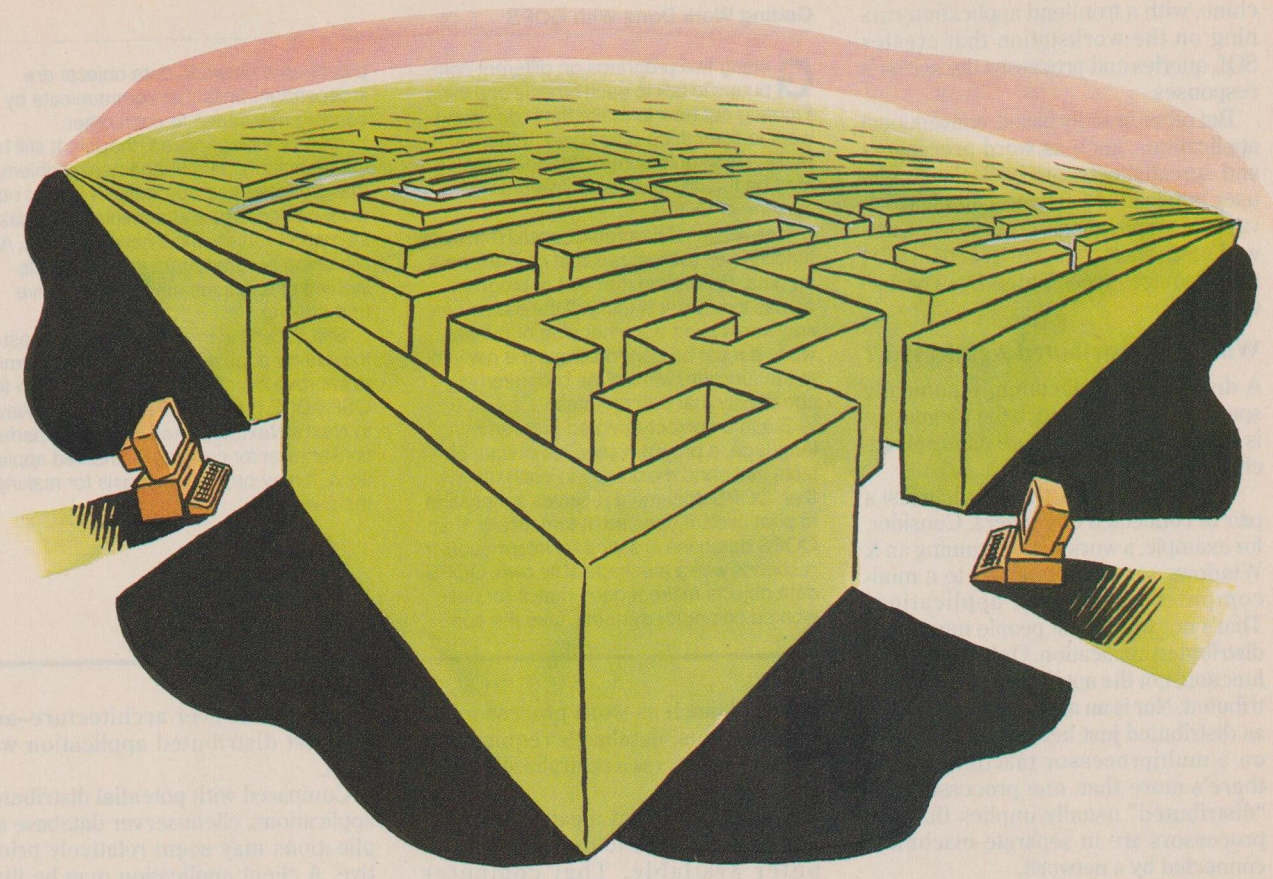

Solving the Distributed Computing Maze

You've installed a distributed database. Now how do you get to distributed computing?

BY FRANK HAYES

Why is the price to implement a distributed application on UNIX so high? Today there are no broadly based, off-the-shelf commercial distributed applications. The best distributed application tools are only intended for creating front ends for databases.

So if you want a distributed application–where a program performs one part of its work on one computer and another part on a different machine–it's possible. But you'll be making a major investment in learning the tools, and you'll have to both design and develop the application yourself.

It's simply because distributed applications are hard to implement. The nuts and bolts have been available for years: network file systems, remote procedure calls (RPCs), message transport protocols. But it's easier to build a "distributed application environment" than to figure out how to do something useful with it.

With ever-larger databases on ever-smaller computers, database vendors want to move as much of the processing work as possible to workstations or other machines. That leaves the database server with only the work of responding to database queries. SQL can put the database server on its own ma-

ROSS MACDONALD

chine, with a front-end application running on the workstation that creates SQL queries and processes the server's responses.

But other broadly based, conventional applications, such as word processors and spreadsheets, are basically single-user applications. There's no clear advantage to spreading the work over a network; in fact, there are distinct disadvantages (see "Three Drawbacks" sidebar).

What is a Distributed Application?

A distributed application, technically speaking, is one in which the computing is split among two or more different machines.

There's more to it, though, than just a pair of connected computers. Consider, for example, a workstation running an X Windows server, connected to a minicomputer running an application. That's not what most people mean by a distributed application. Only the display function, not the application itself, is distributed. Nor is an application described as distributed just because it's running on a multiprocessor machine. True, there's more than one processor–but "distributed" usually implies that the processors are in separate machines, connected by a network.

Distributed applications need communications–not just a network, but real-time communications among machines. For two (or more) processes on different machines to perform real work, they need to exchange data and messages quickly. Casual e-mail won't do. Fortunately, UNIX is well-equipped with the kind of snappy communications required–TCP/IP, Network File System (NFS), and several kinds of RPCs.

But these applications also need a reason to be distributed–a context, as well as a set of tools. Given the significant drawbacks of spreading an application across a network, the benefits of so doing must outweigh those problems. For the most part, conventional applications–and the programming languages from which they're built–assume that an application will run on a single machine. It's possible to split up an application into distributed form–but why? Few conventional applications get significant benefits from being spread across a network.

The Potential of Databases

There's one widely used application that gets plenty of mileage from being distributed: a relational database. Database systems have an unusual structure. Unlike most conventional software, such as word processors or spreadsheets, databases require that many users access a centralized body of data at once.

Traditionally, that meant lots of terminals connected to the largest computer available. That computer handled all database accesses, of course, but it also provided the computer power for individual applications that directly accessed the database to check or update records. As a result, when the number of users exceeded the database computer's capacity, the system slowed to a crawl.

Given the significant drawbacks of spreading an application across a network, the benefits of so doing must outweigh those problems.

But with the advent of SQL and relational databases, something new was added. Instead of directly accessing the database, the front-end application used a query language to access or update records. Because SQL queries and responses are just specialized messages, you could now move the front-end application to a machine other than that on which the relational database server ran. It was the start of database client-server architecture–and the first distributed application was born.

Compared with potential distributed applications, client-server database applications may seem relatively primitive. A client application may be little more than a fill-in-the-blank form on a workstation screen, and the workstation's CPU may be merely requesting records and displaying the results. But if the application seems straightforward, so are the benefits. Once the front end has been moved to workstations, response time improves, often dramatically. That means faster turnaround, even with more users on the system.

Those clear benefits, along with well-developed tools, have helped to push databases even further along the path of distributed applications.

One tool is the 4GL, or "fourth-generation language." 4GLs have a simple (if hardly modest) goal: to let non-wizard programmers create client-server database applications. That means full- scale front ends using as much of a workstation's processor power as possible.

Another database push is for databases that are themselves distributed. A relational database consists of separate tables, so why shouldn't those tables reside on different machines? In fact, it's not a simple problem–comparing tables on two (or more) different machines means moving either lots of data or lots of messages. But as installations abandon large computers in favor of networked workstations,

Getting Work Done With OOPS

Getting two programs on different computers to talk to each other is one thing. Figuring out how to make them do useful work is something else again. If there's really a workable context for doing that, it may be the object-oriented programming system, or OOPS.

Conventional programs consist mostly of functions or subroutines that do their work on data. Spreading that sort of program across a network is tricky. If the data a function wants is on the other side of the network, it must be carted across the network to the function, with all the programming complexity that that requires.

But in an object-oriented programming language, a program consists of data objects that send messages to each other. If an OOPS document receives a message to print itself, it does so automatically. If an OOPS database is asked for information, it responds with a message of its own. OOPS data objects make a good match for networked computer systems. Like the computers on a network, data objects are independent units that communicate by sending messages to each other.

OOPS is no panacea, though. It still has the technical and management problems that all distributed applications share; network bottlenecks and administrative hassles won't vanish with a new paradigm. And retraining programmers to use objects instead of functions may be a massive undertaking.

Still, OOPS is the notion behind most of the cutting-edge environments that promise to improve distributed computing, from the OSF's DCE to Hewlett-Packard's NewWave, to Next's NextStep. And if it's not a perfect final answer for creating distributed applications, it may provide the basis for making them work.

—F.H.

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Three Drawbacks to Distributed Appications

For the most part, both database and non-database distributed applications still hold more promise than practicality. One reason is that it's easy to underestimate the problems inherent in applications that spread their work across a network. Gilbert Wai, executive director for product marketing at database vendor Informix, points to three major disadvantages to distributed applications, database or conventional.

■ *Communications Bandwidth.* A distributed application must move data across the network–and networks don't move data among machines as quickly as data moves within a machine, so the network becomes a bottleneck. "Distributed applications ensure that things run slower each and every time," says Wai.

He's not alone in his assessment. Researchers at Sandia National Laboratories tried linking together mainframes in California and Nevada in hopes of gaining supercomputer performance. They got it–but only as long as the computers kept communication to a minimum. When the system relied on the network for speed, it slowed to a crawl.

■ *Managing data and applications that are spread across a network.* When an application actually depends on more than one processor, there's more than one potential point of failure. For example, if a machine is shut down for maintenance, it affects not only the users logged onto that machine, but also all users of distributed applications that depend on that machine. "There are no clean ways to deal with this," says Wai.

■ *Power Issues.* Third is a non-technical, but in some respects even more difficult, problem: establishing who gets access to which machine, who can change data, and where the data is to be placed. Some users want particular data on their machine; others may object to the constant drain on their system's performance because of remote users.

Unless those technical and maintenance problems are balanced by substantial benefits–as they are for distributed database applications–a distributed application may simply not be worth the trouble.

—F.H.

spreading the data throughout the system may be necessary. And if some data is regularly accessed by some users but only rarely used by others, distributing the database may be the only practical way to go.

The RPC Strikes Back

If database systems seem to have cornered the market for distributed applications, vendors and industry groups haven't given up on the idea of a more generic distributed environment.

The front-runner is Sun Microsystems, with its Open Network Computing (ONC) system. The key to ONC is the Sun RPC remote procedure call, originally developed as part of Sun's NFS network file system. Thanks to the popularity of NFS, Sun says it has far more UNIX and non-UNIX machines equipped for distributed applications–including roughly a million PCs. ONC already claims several dozen applications, most of which were originally built to use Sun RPC.

Meanwhile, the Open Software Foundation has rejected ONC in favor of a distributed environment developed by Apollo (now Hewlett-Packard) for OSF's Distributed Computing Environment (DCE). DCE also includes technology from other vendors, and OSF says DCE is specifically intended to span multiple operating systems. (IBM has already said it will implement DCE on its proprietary mainframes). But while a small body of Apollo-compatible applications already exists, DCE itself does not; in the competition with Sun's ONC, DCE has not yet crossed the starting line.

Both the Sun and Apollo RPCs promise an environment, but what they deliver is a set of tools. Unlike database systems, there are still no obvious distributed applications.

Other Applications to Watch

Among the less-specialized distributed applications with which MIS departments are experimenting are parallels to database servers, including CAD and spreadsheet servers. A CAD server is really just a specialized database server, but a spreadsheet server is likely to require less disk access and more calculating power. Many corporate users find PCs and even workstations too slow to give reasonable performance when recalculating a spreadsheet that represents a complex financial model. A server optimized for performing spreadsheet recalculations makes sense for these users–and also keeps sensitive corporate data in a central machine, rather than on PC floppy disks.

Ordinary text processing seems like the least distributable of applications, but large-scale hypertext systems make more sense. Project Xanadu, a subsidiary of CAD vendor Autodesk, is building applications to organize huge collections of text in which each new entry can include reference links to existing entries. That's an easy trick when the text base is small, but a massive problem when the amount of text is as large as a well-annotated law library.

Yet another approach to distributing applications is Bell Labs' recently unveiled, radical experiment in network architecture, Plan 9 (see UNIXWORLD, September 1990, "Is Plan 9 Sci-Fi or UNIX for the Future?"). Plan 9 is a UNIX-like (but not UNIX-compatible) system architecture in which virtually every major operation can be called from across the network. The file system is transparently distributed among all file servers on the network; the computing capability is also transparently distributed, so that any user can run a program somewhere on the network's computer servers simply by prefixing the command with "CPU."

And though it seems far from conventional MIS applications, distributed computing is finding a perfect fit in factory shop floor automation. A factory floor often consists of many automated machines, each an independent computer. Once they've been made to communicate through a network, they can communicate and coordinate through messages, exactly like any other distributed application–except that instead of balancing the computing load, it's manufacturing that gets spread around.

If some data is regularly accessed by some users but only rarely used by others, distributing the database may be the only way to go.

Hypertext or spreadsheet servers may seem far-fetched, but that's because non-database distributed applications themselves are still in the experimental stages. Designing and building them requires a substantial commitment of time and departmental resources–this is no game for the faint of heart. And in spite of the success of database users in splitting their applications, you shouldn't expect to see easy-to-implement solutions–much less ready-to-use applications–for non-database distributed applications for a long time. □

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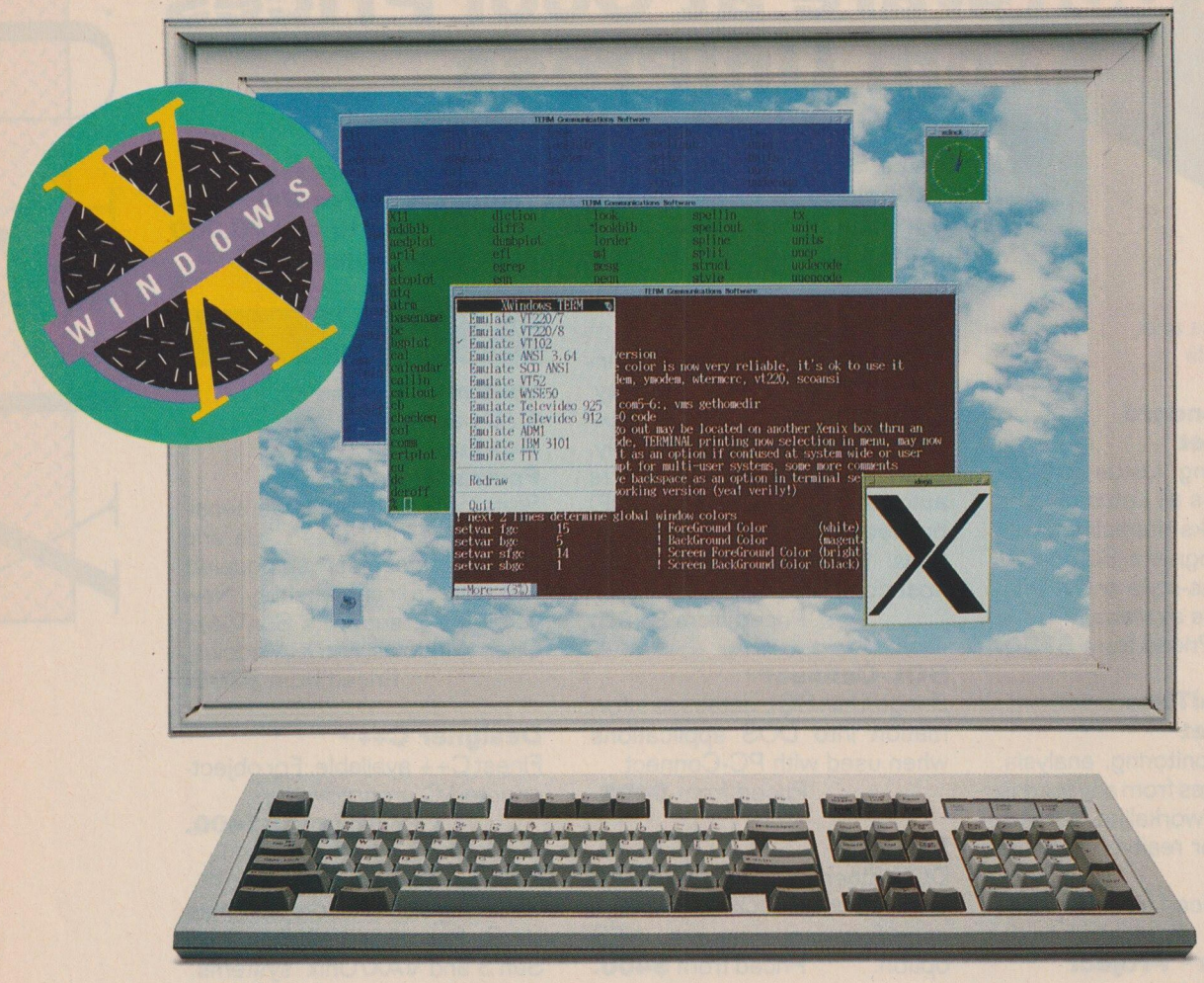

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LINKING TERMINALS ON ETHERNET

By Howard Baldwin

Terminal servers provide access to different hosts and can decrease your connectivity costs

One of the revolutions of the 1980s was the linking of PCs, first into local-area networks and then into wide-area networks. The need for connectivity is true of multiuser UNIX systems as well. If you can link a user at a terminal into multiple hosts, and access the information in any of them, you're optimizing the use and cost of all of the hardware involved.

One way to do this is with a device traditionally known as a terminal server, which acts somewhat like a way station between the host and the terminal. Like many technology products–especially anything called a server–its name can be confusing. Fundamentally, a terminal server lets users at one terminal access multiple hosts with simultaneous sessions. It's a box with jacks for the RS-232 cabling that comes from the terminals or other asynchronous devices. It hooks onto the Ethernet cable via a coaxial tee connector or a drop-cable and a transceiver.

The first terminal servers from Bridge Communications (now 3Com), Ungermann-Bass, and other networking companies were intelligent enough to be called servers. Unfortunately, they frequently used proprietary protocols, either the company's own or XNS (Xerox Network System). Today, you'll find much more functionality and versatility. Because it's an asynchronous device, for instance, you can also plug in modems, printers, and plotters and share them over the network.

One of the biggest and most recent advancements in the terminal server market is in multiprotocol terminal servers. If you have a VAX running

Cisco Systems' low-end terminal server, the STS-10x, features a one-word connection password, bypassing the need to know the host's protocol.

VMS or Ultrix on an Ethernet network, you can access it from a terminal via DEC's proprietary LAT (local-area transport) protocol. If you have another host running UNIX on the same Ethernet network, you can access it from a terminal via TCP/IP. By linking a multiprotocol terminal server to the Ethernet, you can access either host.

You can use the same system with multiple hosts, if you can access them via TCP/IP. Some terminal servers give you even more protocol options, such as the ability to run SLIP (serial line internet protocol) or SNMP (simple network management protocol). (See table.)

In fact, the features you'll find in terminal servers range from simple boxes with four serial ports and one parallel port for about $1,500, to machines costing more than $10,000. The latter category gives you as many protocols as you'll ever need and links up more than 100 terminals and peripherals.

You may not need all those bells and whistles, but terminal servers can help you in two significant ways: they reduce the cost-per-set of network access; and they also give you flexibility in network configuration and management. "They make wiring workgroups much easier than with serial cables," explains Jeff Pack, president of Chase Research. "You can attach a terminal server up to 1,500 meters away from the host, and then attach the terminals." Pack adds that because terminal servers are based on standard protocols, they're not bus-dependent like serial-port boards, and can be used with different hardware.

As functionality increases and prices drop, industry analysts foresee more modern and wider networking choices.

Follow the Money

The most recent research from International Data Corp. (Framingham, Mass.), updated last June, cites a $450 million market this year. "It'll be relatively stable over the next five years," predicts Rick Villars, the manager of IDC's Computing Network Architectures research, anticipating a rise to $470 million by 1992 and then slipping down to $443 million by 1994. At an average price between $4,000 and $5,000, that's about 100,000 terminal servers per year.

What does that mean to you, the buyer? Prices will drop in the next few years. "The market is still growing from the standpoint of nodes, at a rate of about eight percent in unit shipments," explains Villars. "But the price per port is dropping at a considerable rate." That means you'll be able to connect more users for less money. Villars credits the increase in shipments to two factors. He anticipates conversion of older systems into more modern and wider networking solutions, as well as increased penetration of terminal servers into lower-end systems, now that functionality is increasing and prices are dropping.

Now that terminal servers are a "commodity market," Lantronix president Brad Freeburg contends that 80 percent of the users don't need the bells and whistles frequently offered. His company's dual-protocol products weigh 1 1/2 pounds and are small enough to hold in the palm of your hand. "You don't need switches and LEDs and displays. You just need a connector box that allows you to connect printers and terminals to the Ethernet," he insists.

Ray Wymer, president of Star Gate Technologies, one of the latest to venture into terminal servers, concurs

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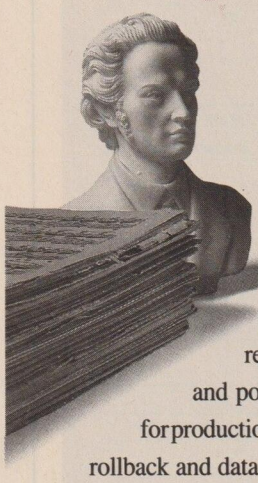

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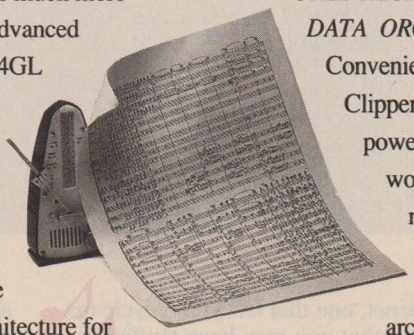

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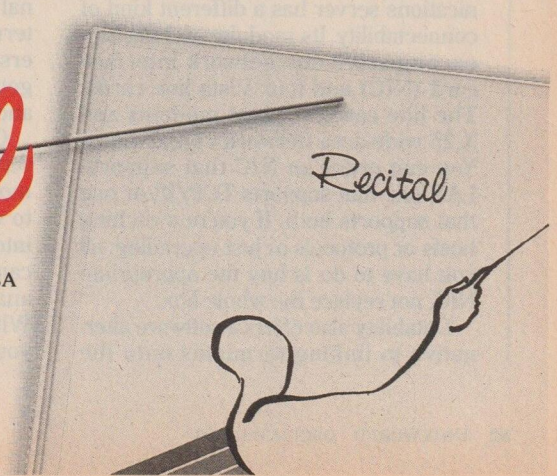

CIRCLE NO. 244 ON INQUIRY CARD

when it comes to sophistication. The product spectrum is wide enough that the choice of a terminal server truly depends on your application. "If you're setting terminals off in a corner for accounting or inventory control, you don't need fancy features–just a connection. If you're hooking up a modem network for a mainframe link over SNA, that may take a different level of sophistication," he says. "Don't overbuy for your application."

The Family Tree

Looking at terminal server vendors, it might help to know their lineage, so you can determine if their expertise matches your needs. For instance, if you're running a system with DEC and UNIX hosts, note that Able Computer, Datability, Emulex, Lantronix, and Xyplex started out as third-party vendors of LAT (see sidebar). Others, like Cisco Systems, descended from the networking side. If you're running a system with a mixture of PCs and UNIX, note that the newest vendors to the terminal server marketplace have expertise in PC-based multiport board solutions: specifically, Chase Research, Digiboard, Equinox, Maxpeed, and Star Gate Technologies. We'll look at each group's products separately. Each product has different features whose appropriateness depends on your needs.

In the area of DEC compatibility, you can always go straight to the source. DEC's own line of terminal servers–the DECserver 200, 250, and 300 (but not the DECserver 550)–offer access over Ethernet to hosts running both VMS and Ultrix. If you're looking at multiple host access, Able Computer's Advance TS016 (the first dual-protocol terminal server on the market) lets each user log into up to four separate links to a host. With this feature you can switch back and forth with a single keyboard command. If you're concerned about expandability, you can take Emulex's base units–either 12-port or 16-port units–and add 16 more ports to each.

Datability's Vista VCP-1000 communications server has a different kind of connectability. Its modular architecture encompasses one network interface card (NIC) and four Vista line cards. The line cards support modems and X.25 wide-area network connections. You can order an NIC that supports LAT, one that supports TCP/IP, or one that supports both. If you're switching hosts or protocols or just upgrading, all you have to do is buy the appropriate NIC, not replace the whole box.

Datability also offers a software alternative to linking terminals onto the Ethernet, one that lets you recycle machines that you may have stuffed in a closet. Installing VistaWare server software on a PC (anything from an 8088- to 486-based machine), PS/2, or VAXmate transforms it into a dual-protocol terminal server for only $695. You can link terminals to the serial ports and printers to the standard parallel ports and get simultaneous connections to DEC and UNIX systems.

Of all the original DEC-compatible vendors, Xyplex seems to be adding the most bells and whistles when it comes to versatility. From a terminal plugged into one of its Maxserver products, you can handle network management and analysis using its MaxView software. With MaxView's three separate tools, you can configure, monitor, and manage any of Xyplex's terminal servers on an Ethernet network. Scope, for instance, is a network analyzer that provides monitoring and packet filtering to detect protocol errors before they cause network downtime.

Three months ago, Xyplex became the first terminal server manufacturer to address security features by adopting Kerberos, the network security standard developed by MIT. Kerberos provides authentication of user identity on local- or wide-area networks. At the same time, Xyplex addressed IBM mainframe access. Users can now link to IBM mainframes via TN3270, an extension of the Telnet protocol suite (common to most terminal servers) that allows emulation of IBM 3270 terminals.

continued

For More Information *(continued)*

Lantronix 26072 Merit Circle #113, Laguna Hills, CA 92653; 714-367-0050

Product	*Number of Ports*	*Base Price*	*Support**
EPS-4	5	$1,495	TCP/IP
ETS-8	8	$1,695	LAT
ETS-16	16	$2,495	

Maxpeed 1180 Chess Dr., Foster City, CA 94404; 415-345-5447

SC Series	16	$2,395	TCP/IP
	24	$3,195	Domain Name Service
	32	$3,995	
	48	$5,195	
	64	$6,395	

Monolithic Systems 7050 S. Tucson Way, Englewood, CO 80112; 303-790-7400

LanConnect	8	$1,895	TCP/IP
	16	$2,935	

Star Gate Technologies 29300 Aurora Rd., Solon, OH 44139; 216-349-1860

MH800/E	8	$2,095	TCP/IP
			Network Analyzer

Xylogics 53 Third Ave., Burlington, MA 01803; 617-272-8140

Annex IIe	16	$4,495	TCP/IP
	32	$6,495	LAT
			SNMP
			SLIP
			Token Ring
			Network Security

Xyplex 330 Codman Hill Rd., Boxborough, MA 01719; 508-264-9900

Maxserver 1100	16	$3,395	TCP/IP
Maxserver 1500	16	$3,795	LAT
Maxserver 1800	16	$4,395	SNMP
Maxserver 4500	8-64	$5,290	TN3270
Maxserver 5000	8-240	$11,290	MaxView
Maxserver 5500	8-224	$14,790	SLIP
			rlogin

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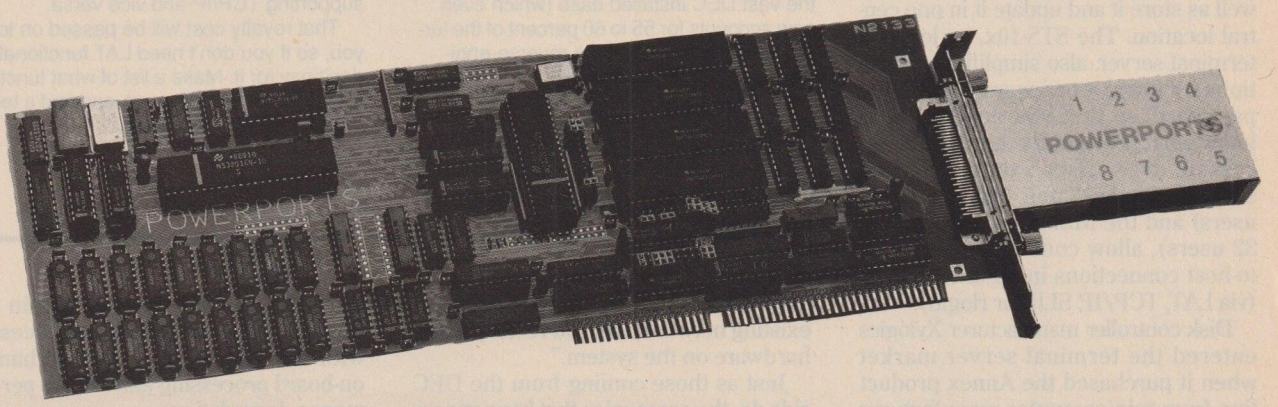

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Outside the original DEC-compatible vendors, Cisco Systems is another example of a vendor offering multiple protocols and versatility. Besides supporting TCP/IP, LAT, and SNMP, its terminal servers feature remote booting. You can load system software from a remote host over the network using the TFTP (trivial file transfer protocol), as well as store it and update it in one central location. The STS-10x, its low-end terminal server, also simplifies connections by using a one-word connection password, so that you don't need to know what protocol the host you're accessing uses. Cisco's other terminal servers, the ASM unit (supporting 96 users) and the MSM unit (supporting 32 users), allow concurrent terminal-to-host connections in up to four ways (via LAT, TCP/IP, SLIP, or rlogin).

Disk controller manufacturer Xylogics entered the terminal server market when it purchased the Annex product line from minicomputer manufacturer Encore. While the devices were originally running only TCP/IP, Xylogics has added LAT capability. If your site has an IBM token ring network, it's the only vendor to offer token ring support as well as Ethernet.

Artecon uses the Annex line to create its TranServer product for Sun network connections, incorporating its own ArteETS software. Using ArteETS, you can attach a single port linked to the terminal server to a name in the UNIX file system. When you bring up applications running under SunOS, it sees what may be a remote serial port as a local port; this means you don't have to modify applications that depend on serial port behavior to run remotely.

Installing a terminal server lets multiple users access expensive peripherals, saving you the need to buy them.

From the Land of Multiports

The difference between a multiport board and a terminal server is simple. A terminal server connects to the Ethernet cable, and not directly to the host, and as such is hardware-independent. A multiport board, on the other hand, requires a slot within a computer. Ray Wymer, president of Star Gate, describes the terminal server as a "zero-slot" expansion device: "It hooks to an existing network, and you're not putting hardware on the system."

Just as those coming from the DEC side do, the companies that have experience in multiport solutions offer several different features, based on different user needs. Star Gate's MH800/E terminal server, for instance, has a built-in network analyzer, which lets you capture network packets, debug network problems, and collect statistics on each protocol layer.

Digiboard's DigiChannel NC/Con-16 terminal server lets you connect up to 16 devices via RJ-45 connectors and supports Telnet connections. Digiboard has written its own TCP/IP interface, which resides in a loadable protocol cartridge. You don't have to download the program code from the network, and when Digiboard updates the protocol, or a different protocol is required, you can update the system with a new cartridge.

Other multiport manufacturers entering the market in the last few months have capitalized on their UNIX-based PC connectivity experience. Equinox Systems unveiled its LAT-compatible ELS-48 terminal server (TCP/IP connectivity is planned for early next year) with a variety of cabling options last summer. The box incorporates an Ethernet board and two 24-port boards based on the company's multiport technology. Two kinds of boards can be installed internally in the ELS-48. The CS (control signals) board has two modem-control signals, and allows cabling of up to 350 feet. The LD (long distance) board allows cabling of up to 3,000 feet.

Chase Research, a UK-based firm whose American office is populated by several alumni from multiport board manufacturer Arnet, sells the IOLAN terminal server. It lets you connect 8 or 16 ports, and includes, like many multiport boards, intelligence within the box: a 16-MHz 80186 microprocessor with one megabyte of RAM to handle on-board processing and reduce performance degradation.

No Loss for Ideas

While you're looking into terminal servers, you might also look at related products for expansion and connectivity. Uninet (Santa Ana, Calif.), for instance, recently released Slat, which connects to the SCSI port of non-expandable workstations and offers either four serial and one parallel interface (for $900), or eight serial and one parallel interface (for $1,600). Similarly, the ST-1000, unveiled by Central Data (Champaign, Ill.) last October, accesses the SCSI port for terminal expansion.

Sometime in 1992, the OSI protocol will come to terminal servers. IDC's Villars doesn't believe that OSI will be a "significant driving force." While he sees it coming into Europe over the next two years, in the United States it'll be limited to vendors targeting government bids. A spokesman for Cisco Systems adds that OSI's virtual terminal protocol (VTP) was tied up in standards committees for a long time, and, as a result, is not being implemented in a lot of host machines.

OSI aside, the advantages of using a terminal server are many. If you're looking for ways to expand your network, and still protect your investment in Ethernet cabling, terminals, and hosts, you can add (or rearrange) networks by installing a terminal server. Even more important, it fulfills one of the fundamentals of networking–it lets multiple users access expensive peripherals that may not be in your immediate area–like laser printers, plotters, and high-speed modems–so you don't need to buy them. □

Check Those LATs

Many terminal servers run both DEC's LAT and the TCP/IP protocol. As a leading vendor of minicomputers and terminals, it was logical for DEC to create its DECserver line of terminal servers in 1984. It was also logical for DEC to tie its user base to a proprietary protocol, dubbed LAT. Terminal server manufacturers targeting the vast DEC installed base (which even now accounts for 55 to 60 percent of the terminal server market) have reverse-engineered the protocol.

Last year, however, DEC decided to license the LAT protocol to anyone who wanted it–including those who had reverse-engineered it. The royalty cost: $15 *per port*. The problem: for those who were already supporting LAT, the royalty cost would be retroactive. While one manufacturer wangled a "cross-technology exchange" with DEC (in exchange for which certain royalty costs were waived), the others have good reason for branching out into multiprotocol functionality. That's why you'll see certain supporters of LAT now supporting TCP/IP and vice versa.

That royalty cost will be passed on to you, so if you don't need LAT functionality, don't pay for it. Make a list of what functionality features you do need, and find a terminal server to fit that niche.

—*H.B.*

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Remember when you were a little kid? Put a penny in the gumball machine and wait to see what would roll out. Sure, you'd want the red one but it seemed like the green one would always appear. Until now, using a video display terminal was like buying a gumball. Cumbersome setup menus and complex commands would leave you hoping for one result but receiving another.

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chapter 15 THE DISAPPEARING RAIN FORESTS

Most tropical forests form a green band around the earth's center extending roughly 10 degrees north and south of the Equator. Amazing as it may seem, these forests occupy less than eight percent of the Earth's entire land mass, yet they account for nearly half of all the growing wood on the planet and are the home for two fifths of Earth's animal and plant species. It is because of the amazing diversity of species that the rain forests are so important to mankind for we rely on these for agriculture, medicine, and industry.

15.1 Natural Source of Products

At least a quarter of all pharmaceutical products are derived from tropical rain forests. An even more impressive statistic when you consider that less than one percent of all Amazon plants have been intensively examined for their medicinal properties.

Tropical rain forests have provided man with treatments for leukemia, Hodgkin's disease, breast, cervical, and testicular cancer as well as a wide array of analgesics, antibiotics, heart drugs, enzymes, hormones, diuretics, anti-parasite compounds, ulcer treatments, dentifrices, laxatives, dysentery treatments and anticoagulants. Of the 90,000 plant species in Latin America, only 10,000 have been tested for anti-cancer properties. Scientists expect that at least ten percent of the untested plants will reveal some form of anti-cancer activity. A species of alexa tree, found in the northern Amazon basin and Madagascar contains the plant alkaloid castanospermine which is being studied at St. Mary's hospital in London as a possible treatment for forms of AIDS.

Vast quantities of rubber from the rain forests provide such mundane items as tires, gum, and running shoes.

15.2 Thousands of Diverse Species

The rain forests are the most complex and diverse ecosystems in the world. A one and a half hectare of rain for-

Figure 15.1 From 1950 to 1975, the amount of the earth's surface covered by tropical rain forest declined 15% to 12%. It is predicted to decline to 7% by the year 2000, and to 4% by the year 2025.

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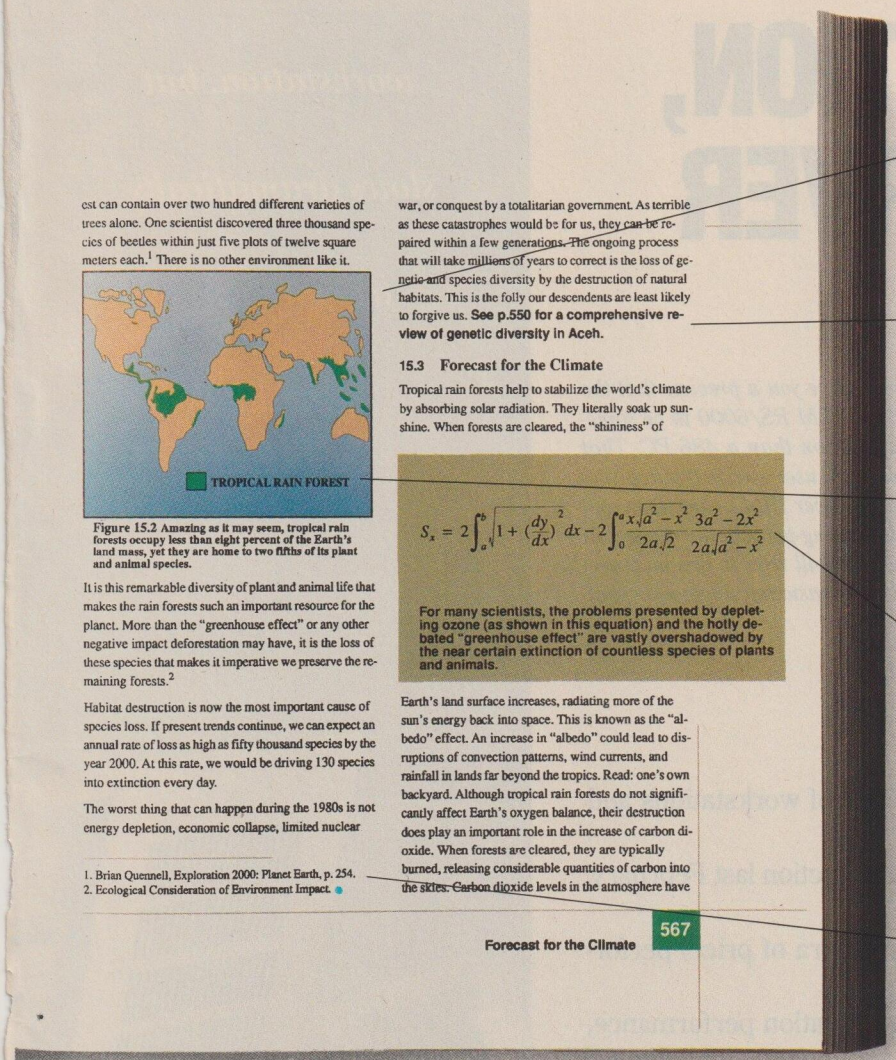

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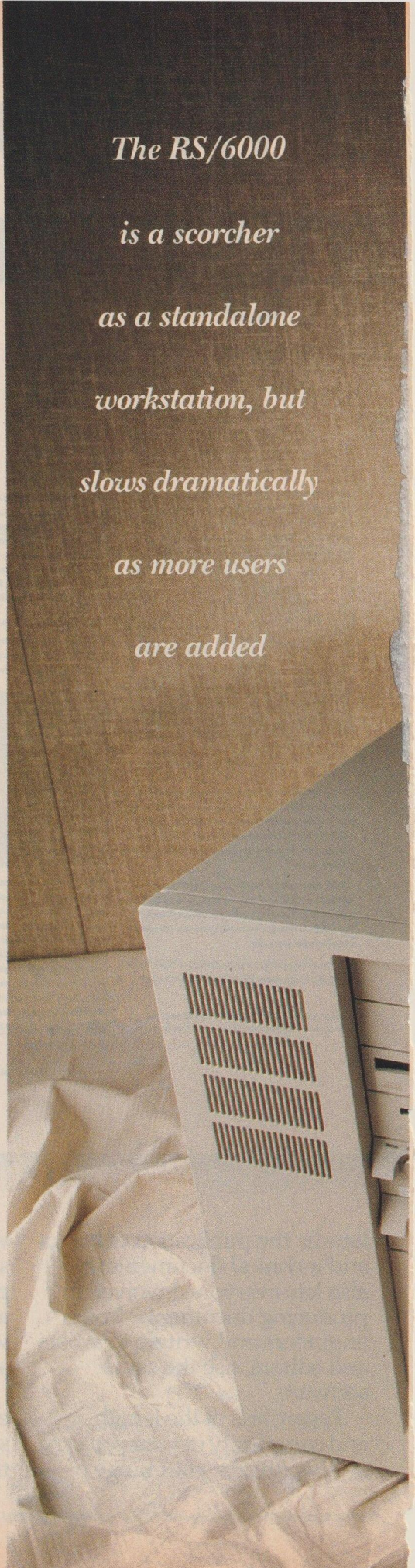
IBM'S FAST WORKSTATION, SLOW SERVER

By Rik Farrow

Editor's note: Our lead item in September's Industry News gave you a preview that the UNIXWORLD/Neal Nelson Multiuser Benchmark found the IBM RS/6000 to be somewhat slower in floating-point operations and integer calculation than a 486 PC. That news item has given rise to controversy, because the benchmark uses **awk** *to test floating-point performance on multiuser systems. In this review, we cover IBM's objections and provide a further explanation of how our benchmark tests floating-point performance. In short, we stand by our benchmark. In the future, however, we will refer to this measurement as the floating-point* **awk** *test to clarify that we are not measuring single-user floating-point performance.*

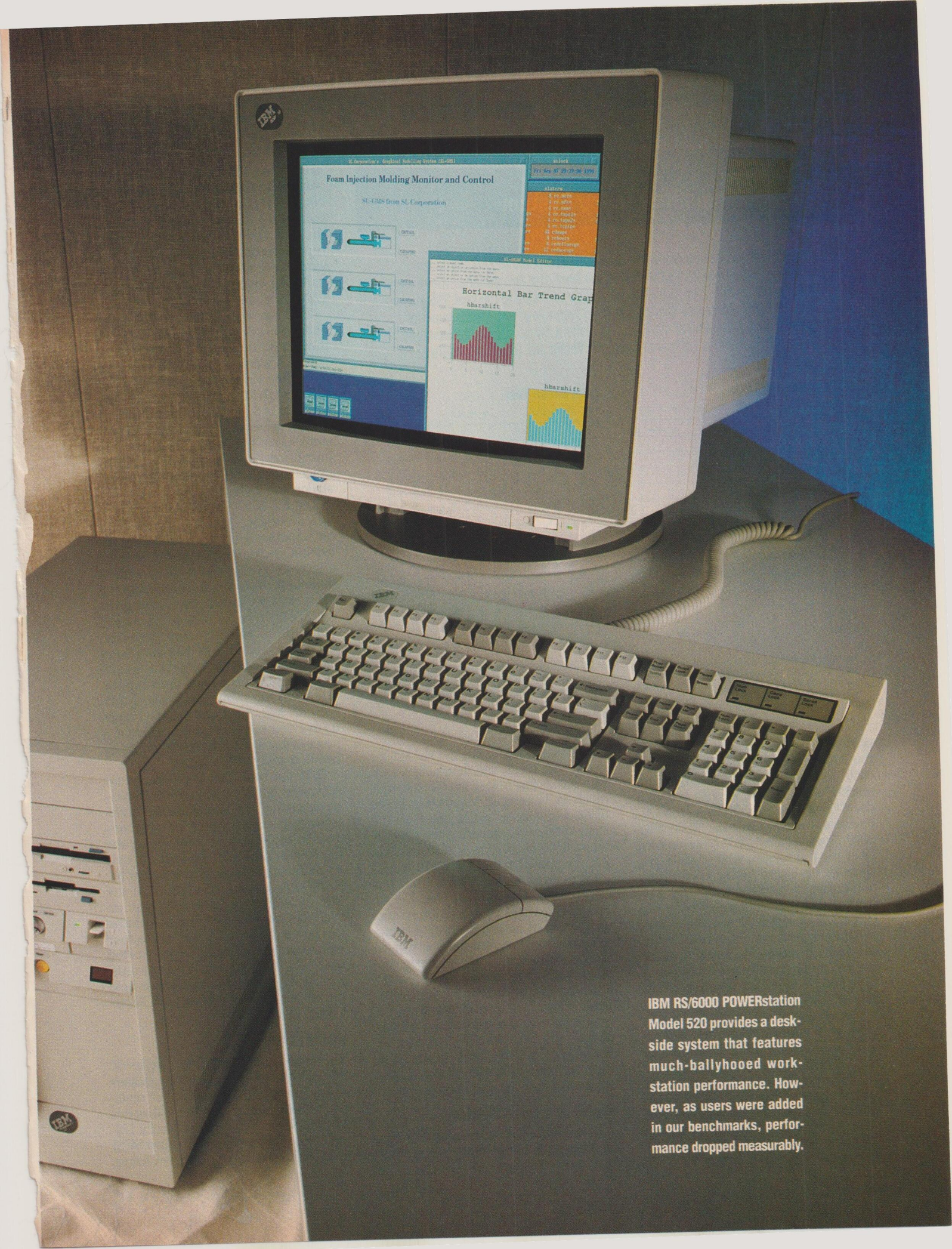
The RS/6000 is a scorcher as a standalone workstation, but slows dramatically as more users are added



JOHN GREENLEIGH

The RISC System/6000, IBM's new line of workstations and servers, has been full of surprises since its introduction last February. Early benchmarks from IBM heralded a new era of price/performance, but these benchmarks portrayed workstation performance, not server performance. Consequently, we put a POWERserver 320 to the multiuser test and learned that this entry-level model barely holds its own, compared to a 486 system.

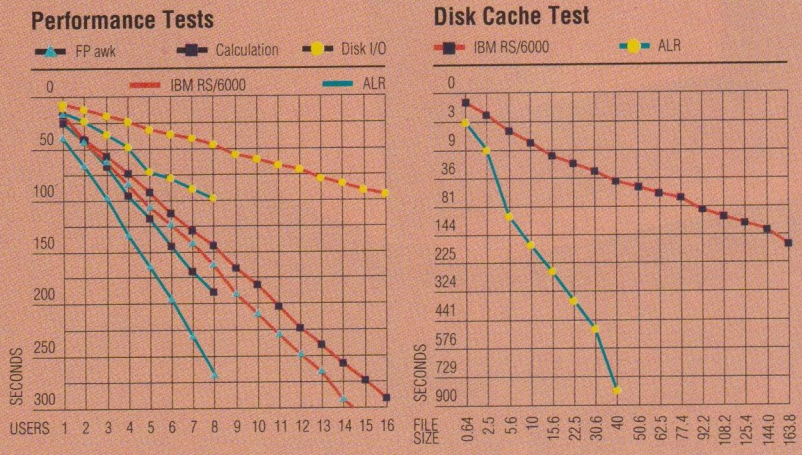
Our findings stem from the UNIXWORLD/Neal Nelson Multiuser Benchmark–perhaps the first well-known multiuser test applied to an RS/6000 system. For comparison, we always contrast our review



IBM RS/6000 POWERstation Model 520 provides a desk-side system that features much-ballyhooed workstation performance. However, as users were added in our benchmarks, performance dropped measurably.

RS/6000 Versus Reference System

The RS/6000 POWERserver 320 scores well compared to the reference machine in the UNIXWORLD/Neal Nelson Multiuser Benchmark. The reference machine is an ALR Flexcache 386/33 and performs up to the best 386 standards. The RS/6000 represents the latest in RISC technology and shows superior performance compared to the ALR. The pattern, however, is not maintained when the RS/6000 is compared to the HP Vectra 486 (see other figure).



The IBM RS/6000 Model 320, as tested, was configured with IBM's AIX 3 version of UNIX, a 20-MHz processor, 32 megabytes of memory, two 320-megabyte hard disk drives, an integrated floating-point unit, and a 64-port serial card. (Note that the RS/6000 Model 320 and the Model 530, which served as the SPECmark test system, are equipped with the same processor.) The ALR Flexcache 386/33 was configured with 15 megabytes of memory and tested under SCO XENIX 2.3.2.

system against our reference machine, the ALR Flexcache 33/386 (see "RS/6000 Versus Reference System" benchmark). In this review, we also compare the POWERserver 320 to a Hewlett-Packard 486 system (see "IBM RS/6000 Slows Against 486" benchmark). Over the four-month course of this review, we evaluated both a POWERstation 320 and a POWERstation 520. The workstation performance of these machines, which share the same processor and memory subsystem, is reflected by the SPEC (Systems Performance Evaluation Cooperative) benchmark (see "RS/6000 Scores Impressive SPEC Rating" benchmark).

The results of our multiuser benchmark are unequivocal. In the floating-point **awk** test, the POWERserver 320 ran 27.5 to 33 percent slower than the HP 486. In integer/calculation tests, the disparity was not as dramatic, but the POWERserver 320 still ran 15.7 to 27.5 percent slower than the HP 486. On disk I/O tests, however, the POWERserver ran neck and neck with the HP 486 for one to four users, and then pulled away with scores that bested the HP 486 by as much as 34 percent. Meanwhile, in the SPEC workstation testing, the POWERstation 520 easily outperformed a DECstation 3100 by posting a SPECmark of 22.3, compared to the 3100's 10.1 mark.

As a result of our testing, IBM has criticized the UNIXWORLD/Neal Nelson benchmark. IBM has focused its criticism on the use of **awk** to quantify floating-point performance, leaving uncriticized the benchmark's integer performance component. In addition, IBM has issued a press release criticizing the entire benchmark, but the criticism was general in nature, and did not specifically address the use of **awk**. We stand by the test results, believing that, in the least, they indicate something amiss in the RS/6000's multiuser performance.

Big Blue's UNIX Strategy

IBM says it plans to gain worldwide market leadership in the total UNIX market in two years. IBM's current share of the workstation market is less than 2 percent, with Sun, HP, and Digital Equipment Corp. holding the lion's share. Of the first 2,000 RS/6000s shipped, IBM reported that 57 percent of the units were workstations, 35 percent were multiuser systems, and 8 percent were LAN (local-area network) servers.

IBM has worked hard at getting applications ported to the RS/6000. Although both the CPU and operating system are proprietary, IBM says it has more than 150 software applications for AIX, its UNIX operating system. IBM has four U.S. porting centers, and two foreign ones, and plans to have 15 operating within two years. The current applications range from CAD/CAM to office automation, covering both workstation and multiuser uses.

The RS/6000 runs AT&T System V-based version, AIX. It includes some outstanding improvements to the file system, including the unprecedented ability to resize file systems while mounted. More subtle changes to the file system and device driver have given the RS/6000 faster disk performance than other systems using the same SCSI hard disks. AIX has also been modified to make the kernel more modular and to support real-time applications. On the other hand, using AIX requires learning a new set of administrative commands and procedures, a process that is aided by a system administration utility called **smit**.

IBM hardware has a reputation for rock-solid integrity, and the RS/6000 is no exception. The MicroChannel Architecture makes it possible for other vendors to build products for either the RS/6000 or the PS/2 line, although only a handful of products exist today for the RS/6000's enhanced version of the MicroChannel. A closer look also reveals that the RS/6000 design includes the hooks for other buses–up to four buses can concurrently be supported by the RS/6000 chip set. In other words, a full-fledged channel (mainframe bus) can replace the relatively sluggish MicroChannel bus.

Brute Force

The reviewed system was a deskside POWERstation 520, with 32 megabytes of main memory, a 19-inch color monitor, color display adapter, Ethernet adapter, SCSI adapter, high-capacity 1/4-inch tape, Exabyte 8mm, and two SCSI disks with a total of 1.2 gigabytes, listing

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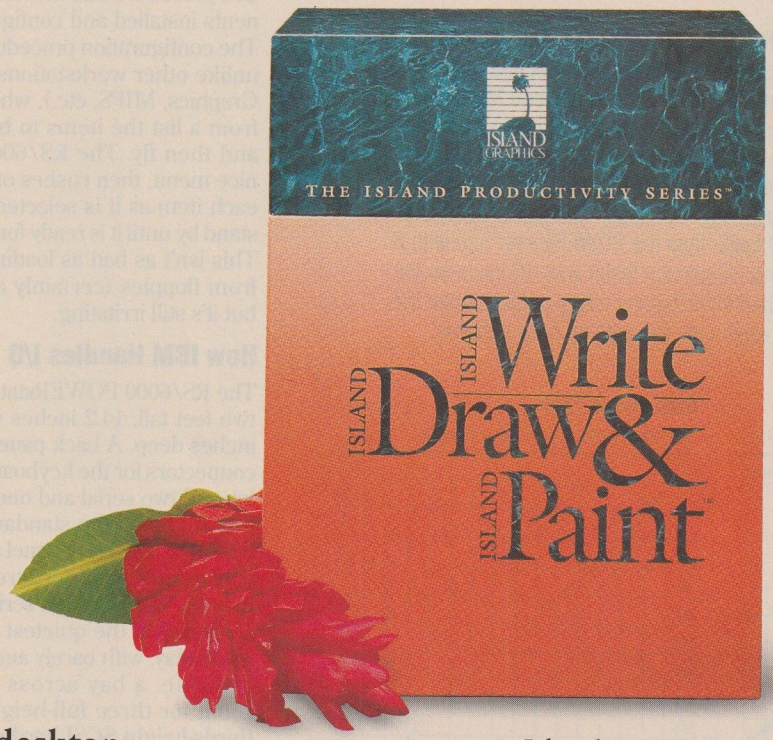

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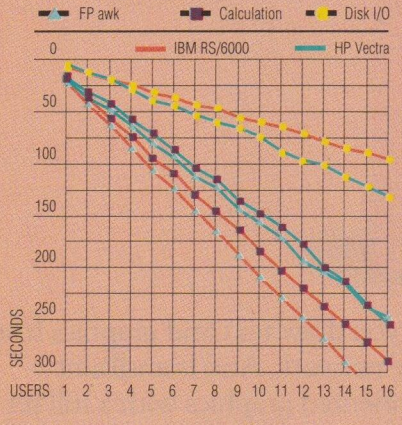
CIRCLE NO. 186 ON INQUIRY CARD

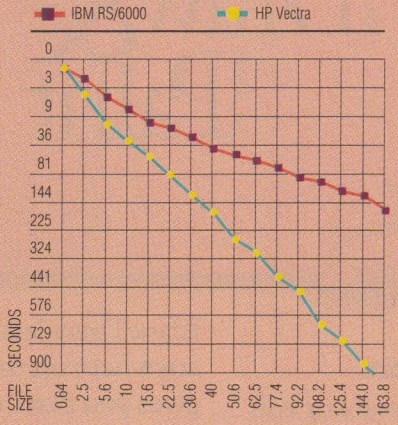
IBM RS/6000 Slows Against 486

Under multiuser loads, the IBM RS/6000 POWERserver 320 is slower than a Hewlett-Packard Vectra 486 system in floating-point awk and integer calculation tests, according to the UNIXWORLD/Neal Nelson Multiuser Benchmark. In the awk test, which exercises a system's floating-point capabilities without using native optimizing compilers, the Vectra 486 performed up to 33 percent faster than the POWERserver 320 (when 16 users were present on the test systems). In integer calculation tests, the Vectra 486 score was 27 percent faster than the POWERserver 320 with 5 users on the test systems, but only 16 percent faster with 16 users on the test systems. In disk I/O tests, the POWERserver easily outperformed the Vectra 486, scoring 34 percent better with 16 users on both systems.

Performance Tests



Disk Cache Test



The IBM RS/6000 Model 320, as tested, was configured with IBM's AIX 3.0 version of UNIX, a 20-MHz processor, 32 megabytes of memory, two 320-megabyte hard disk drives, an integrated floating-point unit, and a 64-port serial card. (Note that the RS/6000 Model 320 and the Model 530, which served as the SPECmark test system, are equipped with the same processor.) The configuration of the HP Vectra 486, which ran under SCO UNIX, consisted of 16 megabytes of memory, 300-megabyte hard disk, and built-in math co-processor.

for $65,223. The 520 runs at the same clock speed as the desktop 320 (20 MHz), but has twice as many memory and MicroChannel slots. A base-level 520 sells for $27,245, with 8 megabytes of memory, grayscale display, 19-inch monitor, Ethernet, floppy, and 355 megabytes of disk. An entry-level 320 system goes for $12,995.

This machine will please most workstation users with its excellent performance. Die-hard BSD-users will certainly be annoyed by differences between AIX and BSD commands and administration, but the choice between the speed and familiarity will most likely be won by brute force–speed. As far as using the RS/6000 as a multiuser system, it will provide reasonable multiuser performance, but at a price/performance ratio that favors less expensive solutions.

Installation Blues

The RS/6000 showed up in the usual assortment of boxes, but with one important part missing. IBM plans to have Customer Engineers install the hardware, and there were no installation instructions and precious little documentation. On-line manuals and the InfoExplorer (a help system) will help you once you get going, but there are no descriptions of ports or cables. Connecting a printer without a Customer Engineer seems unlikely until you notice that the connectors bear a certain resemblance to those used by IBM PCs. As far as installation goes, most of the cables will only fit one socket, and anyone who has installed workstations before can set up the RS/6000.

The RS/6000 arrives with the AIX software already installed. Like many other workstations, you go through an installation procedure that identifies the components installed and configures a kernel. The configuration procedure is iterative, unlike other workstations (Sun, Silicon Graphics, MIPS, etc.), where you select from a list the items to be configured, and then fly. The RS/6000 presents a nice menu, then rushes off to configure each item as it is selected, making you stand by until it is ready for the next item. This isn't as bad as loading SCO UNIX from floppies (certainly a lot quicker), but it's still irritating.

How IBM Handles I/O

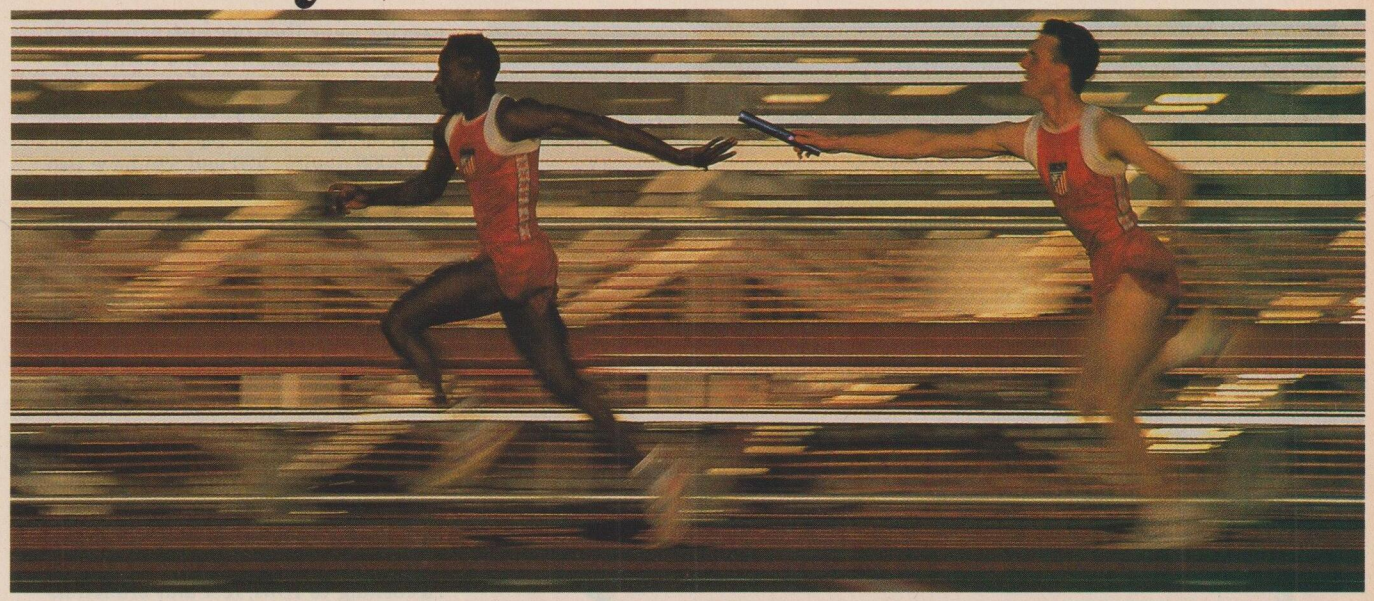
The RS/6000 POWERstation 520 stands two feet tall, 14.2 inches wide, and 26.6 inches deep. A back panel conceals the connectors for the keyboard, mouse, tablet, and two serial and one parallel ports that make up the standard I/O for the RS/6000. This back panel also covers the connectors to the MicroChannel bus boards. The POWER series, in general, are some of the quietest systems available today, with barely audible fans.

Inside, a bay across the base has room for three full-height or six two-thirds-height SCSI hard drives. The remainder of the interior is divided into a narrow power supply compartment on the right side, and space for components on the left. Instead of the single large motherboard found in most workstations, the RS/6000 has three boards, which IBM calls planars (the same term used to describe similar mainframe components). The standard I/O planar plugs into the 44-pin connector on the back of the I/O planar, which holds the MicroChannel slots. The standard I/O planar contains the floppy disk interface for two internal floppy drives, along with support for peripheral devices.

What is missing is the SCSI disk, graphics, and LAN controllers often found as part of the standard I/O. In the RS/6000, these controllers take up MicroChannel slots, leaving five slots free in a 520, and only one slot free in a 320. The I/O planar connects to the CPU planar through a 240-pin connector. The MicroChannel slots and standard I/O are isolated from the CPU planar by buffers. The connection to the System I/O bus and the MicroChannel is through the I/O Channel Controller (IOCC), supporting the 10-MHz 32-bit

DBMS Case Study:

Security for the Goodwill Games™*



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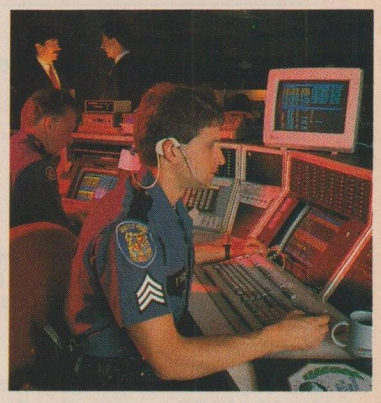

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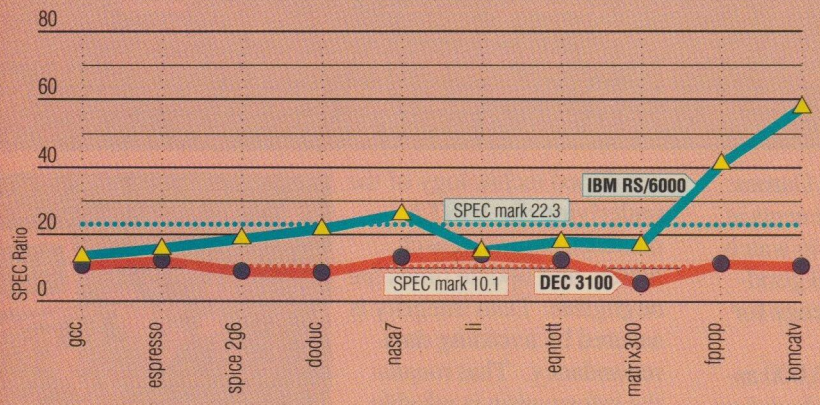
UW120

CIRCLE NO. 90 ON INQUIRY CARD

RS/6000 Scores Impressive SPEC Rating

IBM's RS/6000 performs well overall on the SPEC benchmark, with integer performance equal to a MIPS-based R3000 workstation. The SPECmark shows the RS6000 to be an exceptional performer in floating-point intensive tasks (nasa7, fpppp, and tomcatv), which contradicts the UNIXWORLD/ Neal Nelson benchmark. Note that the SPEC benchmark programs are run one-at-a-time, unlike the multiuser benchmarks in which many programs are run concurrently. This difference may be the reason for the discrepancy between the two sets of benchmark results.



The system tested was RS/6000 Model 520, with 32 megabytes of RAM, 32 kilobytes of data cache, and 8 kilobytes of instruction cache, running with a 20-MHz clock. The Model 320 runs at the same clock speed, with the same processor and amounts of cache.

MicroChannel bus on one side. The other side of the IOCC connects directly to the System I/O bus, a bus running at the same speed as the processor (20-30 MHz), and 64 bits wide. The IOCC buffers data for transfer between the wider, faster memory bus and the slower and narrower MicroChannel.

The RS/6000 MicroChannel has been modified to support a streaming data mode for increased performance. Streaming data permits the MicroChannel to transfer multiple data units without having to interspace bus control cycles between each data transfer, almost doubling the throughput of the MicroChannel. The PS/2 MicroChannel achieves a maximum burst rate of about 19 megabytes per second, and the RS/6000 tops out at about 37 megabytes per second.

Neither of these figures is for sustained data transfers, which would be lower because of the additional overhead for bus control cycles. By comparison, the SPARCstation S-Bus can achieve burst rates of 80 megabytes per second with a 20-MHz clock.

Looking at the design of the three planars, you immediately notice that the I/O is physically segregated. The RS/6000 has been designed to handle up to four I/O Channel Controllers, each of which can support 64-bit data transfers at the system clock speed. With a 20-MHz system clock, an RS/6000 could support four 160-megabytes-per-second I/O buses. These I/O buses would not be attached to MicroChannels–they are more akin to the channels in IBM mainframes. Imagine that instead of the I/O planar containing the MicroChannel there were a higher performance bus connected to that 160-megabytes-per-second I/O Channel Controller. IBM has built expansion capabilities into this design, for which they claim to have no immediate plans.

Scalar RISC

Much has already been written about the RS/6000 CPU chip set (see April 1990 UNIXWORLD). This RISC processor has been broken into closely coupled functional units so that it is possible to execute more than one instruction each cycle. To accomplish this feat, there must be multiple instruction processors, fast cache memory, and a means to keep the instruction pipeline full. The RS/6000 models 320 and 520 have two processors (one integer and one floating point), 32 kilobytes of data cache, and an instruction unit with 8 kilobytes of instruction cache.

The instruction unit pre-fetches instructions, and attempts to keep the instruction pipeline full by anticipating branches. The instruction unit can also perform tests on the results of either integer or floating-point instructions. Because the instruction unit both handles branch instructions (GOTOs) and comparisons (did the last operation result in zero?), it can execute these two instructions during the same clock cycle. According to IBM, test and branch instructions make up 30 percent of average code, making the instruction unit's capabilities important.

The integer unit performs integer operations, such as add, subtract, multiply, divide, bit manipulation, and logical operations. The integer unit also creates real memory addresses out of virtual addresses, a task which it must also do for the floating-point processor. The integer unit performs the load and store operations for the floating-point unit, so that when a register in the floating-point unit is loaded from memory or written back, the integer unit does the address work.

The floating-point unit has a two-cycle pipeline. An instruction can complete every cycle while the pipeline is full, but it takes two cycles for each floating-point instruction from start to finish. The floating-point unit includes a combined multiply and add instruction, using an internal 160-bit register, which can multiply two 64-bit numbers together and add the result to a third, all in two cycles. Most floating-point units are co-processors that do not work in parallel, and require six or more cycles to complete an operation. The RS/6000 is the fastest floating-point unit available, outside of a mainframe.

The four-way, set associate, data cache handles all memory references. In the event of a cache miss, the missing data is read from dual-interleaved main memory, using a 64-bit-wide bus. Replacing a cache line takes two memory reads, which will be interleaved when there are two memory cards, or completed in the same time if the 16 bytes all fall in the same 4-kilobyte page. Error-

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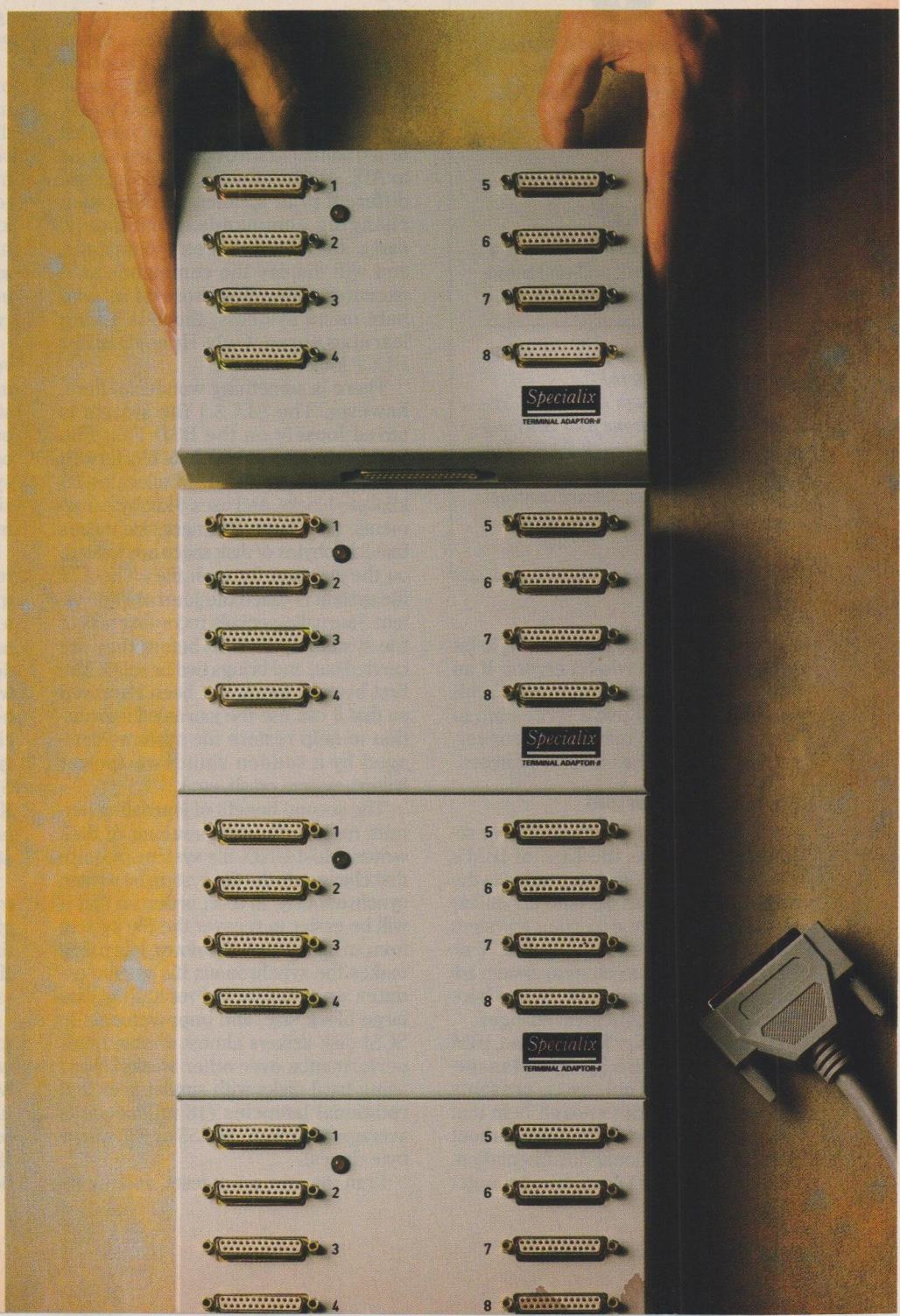

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correcting logic can correct single-bit errors and detect two-bit errors. If an errant memory chip is detected, bit steering logic will use a spare chip to replace the failed memory. Error-correcting logic watches data on all buses.

An Upgraded Variant

AIX grew out of a determination to replace System V as the base of IBM's UNIX systems. AIX has succeeded to the point that much has become unfamiliar territory. If you are expecting a system that is similar to either a System V or BSD variant when it comes to system administration, you can forget it. It is here that IBM has wrought great changes.

To make life easier for everyone, IBM includes **smit**, the System Management Interface Tool. **smit** presents menus, and includes enough help that you can do most routine tasks without reading any additional documentation. One thing you can't do with **smit** is get the RS/6000 to allow other workstations to mount it. Several hours of determined hacking and traditional system administration succeeded in a task taking a few minutes on other workstations.

IBM includes default security in AIX 3.1, so you cannot edit the password file to add users. You can, however, create scripts that will permit you to behave as you would in a BSD-based system. The file **/usr/lpp/bsdadm** contains 39 pages of information to help the BSD administrator understand how to do things with AIX. Included was a useful replacement for **vipw** and another script for importing BSD-style password files and converting them to AIX painlessly. The document also has a list of 120 administrative commands unique to AIX. AIX has a different file system, different print spooler, configuration changing commands. Fortunately, **smit** knows about these commands, and will display the commands as it executes them. For those of us who hate menu systems, there is a long learning curve. Only HoneyDanBer UUCP looked familiar.

There is something wonderful here, however. The AIX 3.1 file system is based loosely on the BSD Fast File System. Instead of 8-kilobyte blocks with 1-kilobyte fragments, IBM allocates 16-kilobyte blocks, and uses 4-kilobyte fragments. (The large fragment size means that 2 kilobytes of disk space are wasted, on the average, for each file.) The AIX file system is called the Journal File System. Journaling entails recording sets of file system operations before they are carried out, and brings two benefits. The first benefit, **fsck**, has been improved so that it can use the journaled information to help restore file systems damaged by a sudden shutdown (power failure, system crash, etc.)

The second benefit of journaling permits more efficient queueing of disk writes. Most UNIX file systems require that changes to the file system be written synchronously, in a set order, so that it will be easier to recover the file system from an unexpected shutdown. Journaling makes the synchronous file system updates unnecessary. Journaling, the large block size, and improvements to SCSI disk drivers almost doubled disk performance over other workstations using hard disks with similar seek and rotational latencies (18 milliseconds average seek with the 355 or 670 megabyte drives).

I ran my own set of tests, and my results concurred with the experiences of other workstation users. For example, loading a set of source files took 9 minutes on the RS/6000 and 21 minutes for a Sun-4/110, both reading from the same network file server.

But I had yet another surprise. Wandering through **smit**, I noticed a menu that apparently allowed me to *increase* the size of a file system *while it was mounted*. I know that the UNIX system will not let you do this, so I tried it (guessing that **smit** would stop me if I was doing the wrong thing).

It worked! AIX takes the abstraction of the logical disk and extends it to include multiple hard disks. Several disks can be treated as a single *logical volume*, and file systems are mapped into this volume. Extending a file system adds more disk space from the logical volume to the file system (if you haven't already exhausted the volume). **smit** also calls a command (**chfs**) that increases the size of the file system and creates new cylinder groups.

Using these techniques made me very happy. The usual route is that you must establish file systems *before* installing any software. Then, if you run out of room, you must go back to square one and establish different-sized file systems. AIX's ability to increase the size of file systems is a great improvement to UNIX.

There were other quirks in the system. The C shell, for example, doesn't quite work right. If your PATH contains a non-existent directory, the C shell hangs, effectively destroying the window you were using. Discovering this was fun. Also, changing to another user's home directory with **cd ~johnd** (for changing to **johnd**'s home directory) fails. AIX's designers, coming from a System V background, all used the Korn shell, and failed to notice these problems. Most of the rest of the workstation world uses the C shell.

AIX includes all the commands commonly used in System V and BSD, and gives you a choice of either world by putting one or the other first in your PATH. IBM also included the InfoExplorer, an alternative to **man** pages and help systems.

IBM has been more successful than most system vendors in getting software to support the new architecture. Many CAD/CAM and graphics packages have been ported, including packages originally written for the Silicon Graphics IRIS workstation. For multiuser applications, there are Informix, Ingres, Oracle,

Progress databases and 4GLs, UniPlex office automation, and Fourgen's accounting system.

Final Word on Benchmarks

The POWERstations 320 and 520 have identical SPECmarks–22.3, more than double that of the DECstation 3100 (10.1), the MIPS 2030 (9.3), and the SPARCstation SLC (8.3). Using a 100-by-100 matrix Linpack, the 320 and 520 perform at 7.3 megaflops, a rate several times the performance of other workstations.

One reason the POWERserver 320 scored disappointingly in the UNIX WORLD/Neal Nelson test is due to the use of **awk**. I wrote a C and **awk** programs similar to the benchmark script and ran it on the POWERstation 520 (which was not encumbered by Remote Terminal Emulator activity, as is the case with the benchmark). The benefit of using C is it can take advantage of the RS/6000's optimizing compiler. Conversely, **awk** is an interpreted language and adds its own overhead to the benchmark.

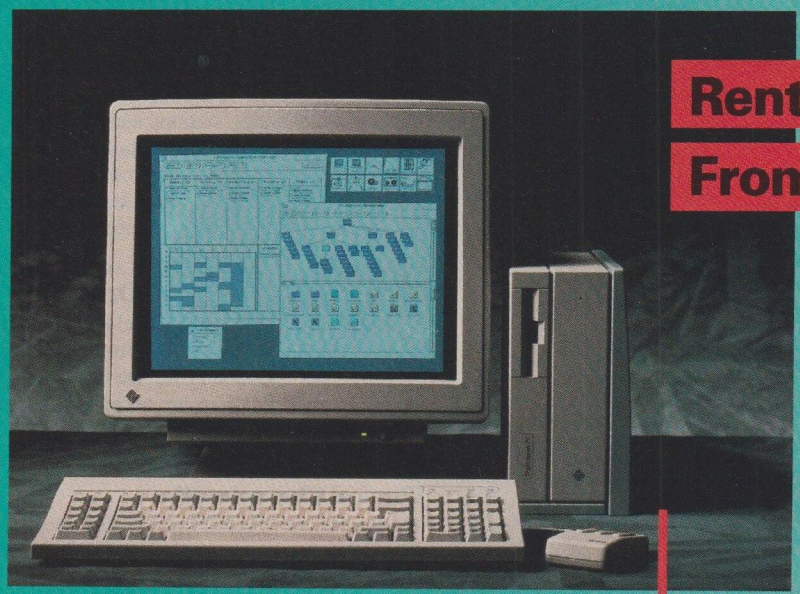
The comparable **awk** program ran 107 times slower than a C program performing the same calculations on the RS/6000. On an 88000-based Data General Aviion workstation, **awk** was 20 times slower than the C program, and on a SPARCstation, **awk** was 27 times slower. Neither of these comparative workstations showed the enormous disparity in performance between **awk** and a compiled program seen in the RS/6000. One likely source for the lower-than-expected multiuser performance of the RS/6000 is a disruption in the instruction pipeline.

The RS/6000 owes part of its high performance to its ability to execute multiple instructions during a single cycle. This superscalar performance relies on keeping the instruction pipeline filled. In multiuser tasks, the context switching (changing between different processes) disrupts the pipeline and instruction cache, ruining the superscalar performance because the processing units are starved for instructions.

Once the RS/6000 is no longer executing multiple instructions per cycle, it stands to reason that a 486 with a faster clock will perform nearly as well or better. All the workstation benchmarks at which the RS/6000 excels are performed one process at a time, with no competition from other processes. Thus, the workstation benchmarks, such as the SPECmark or Whetstones, do not show true multiuser potential.

Benchmarks aside, the RS/6000 models are exciting. If you are in the market for a workstation, a POWERstation model is probably the hottest box for the money. But multiuser buyers beware: you can get a better deal by purchasing a less expensive 486 system. ■

Rik Farrow is a software engineer, and coauthor of a book on UNIX system administration. He teaches courses on system administration and system security.



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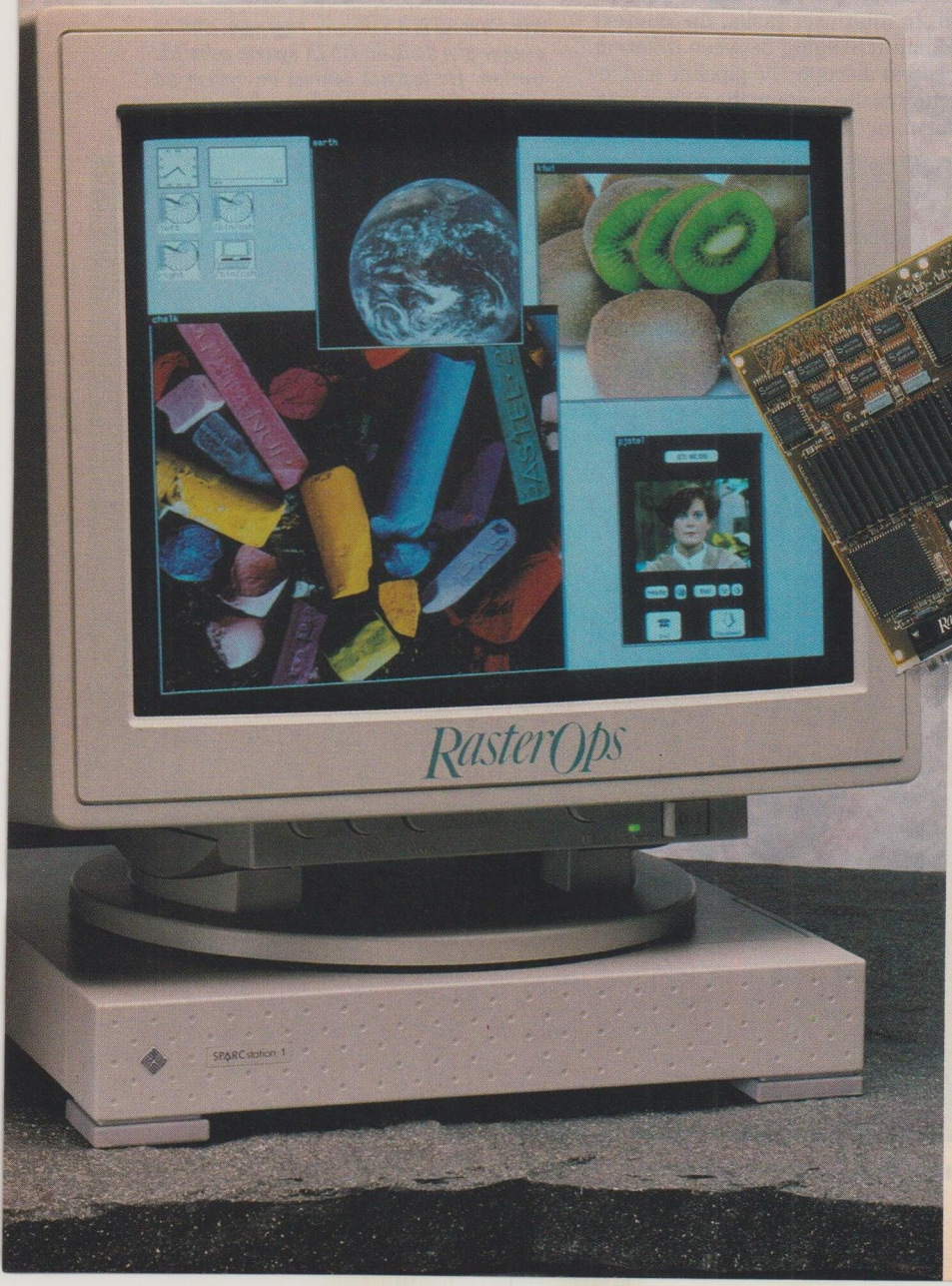

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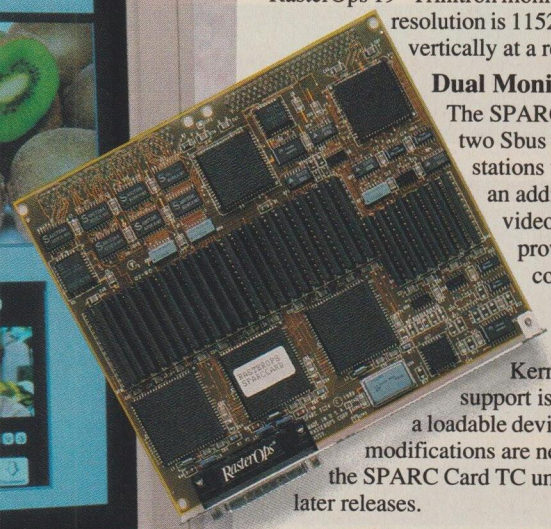
Screen Resolution and Monitor Support

The SPARC Card TC supports Sun's standard 19" and 16" color monitors, as well as supporting RasterOps 19" Trinitron monitors. The pixel resolution is 1152 horizontally by 900 vertically at a refresh rate of 66 Hz.



Dual Monitor Use

The SPARC Card TC requires two Sbus slots. On SPARCstations with three Sbus slots an additional single slot video card can be used to provide a dual-headed configuration.

Loadable Device Driver

Kernel level device support is implemented using a loadable device driver. No kernel modifications are necessary to support the SPARC Card TC under Sun OS 4.1 or later releases.

Physical Characteristics

The RasterOps SPARC Card TC is a double size SPARCstation expansion board. It uses two Sbus slots and 1.7 amps at 5 volts.

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CIRCLE NO. 163 ON INQUIRY CARD

A REAL-TIME SPREADSHEET FOR THE '90S

By Mike Burgard

The first major product to run under Sun's Open Windows, Access 20/20 has real-time power

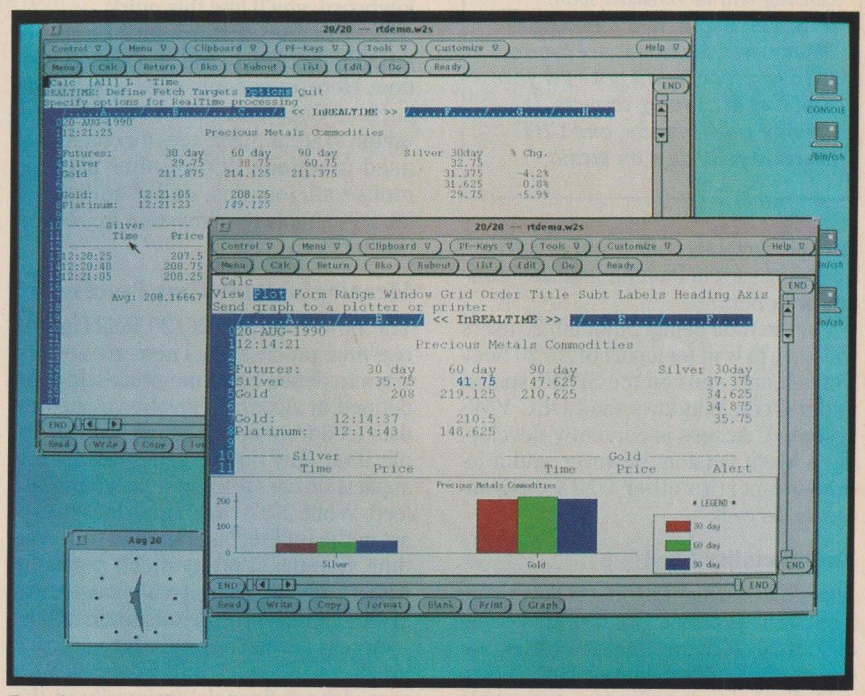
With 20/20 RealTime, Access Technology has turned a solid spreadsheet into a forward-looking product that will carry you into the mid-1990s. The addition of real-time processing and Open Windows 2.0 makes it the most complete spreadsheet in the UNIX community, even when compared to the new UNIX spreadsheets from Lotus and Informix.

But all is not perfect with 20/20 RealTime. Its Open Windows port, while the first by a major vendor, falls short of the standard graphical user interface envisioned by Sun and AT&T when they designed Open Look (Open Windows is the name Sun chose for its Open Look environment). Even so, Access' implementation of 20/20 gives you most of the tools you would expect from an X Windows-based interface. Also far from perfect is Access' selection of fonts and presentation tools. They are generally unimproved from previous versions of 20/20, but are nonetheless adequate.

The most important aspect of 20/20 RealTime is real-time processing, a hot item for financial firms, automated factories, scientists, and engineers, among others. Major competitors in this realm–Lotus 1-2-3 under OS/2 and Q-Calc under UNIX– don't begin to approach 20/20 RealTime. Of course, you pay more for this power: $1,800 for 20/20 RealTime and about another $18,000 for a Sun SPARCstation 1+. The product is also available on the SPARCstation 1, which sells for under $10,000. Traditional 20/20 on a multiuser 386, with support for six users, also costs about $10,000.

To be sure, Access now qualifies as a workstation software vendor, quite a departure from its origins. Access began life in 1980 as a UNIX multiuser shop. Contrasted to Lotus 1-2-3 and Informix's Wingz, Access 20/20 is a veritable UNIX institution. The standard version runs on more than 70 platforms and gives you all the basic tools you need from a spreadsheet, including recalculation, macros, cell linking, mathematical functions, file importing, and database features similar to Lotus 1-2-3. Access 20/20 also stands out because of its database query facility called Database Connection and its built-in auditing features.

I tested 20/20 RealTime on a SPARCstation 1+ with 8 megabytes of RAM, a 100-megabyte hard disk, and color monitor. The product requires about 5 megabytes of hard disk and 6 megabytes of memory. 20/20 RealTime runs under Open Windows rather than under SunView, as do Wingz and 1-2-3. The only hardware problem I experienced was the inability of the mouse to



Running under Sun's Open Windows, Access' 20/20 RealTime spreadsheet provides most of the tools you would expect from an X Windows-based interface.

REVIEW HIGHLIGHTS

20/20 RealTime Spreadsheet
Access Technology, Inc.
Two Natick Executive Park
Natick, MA 01760
508-655-9191

Robust real-time capability with strong third-party support, Open Look interface running under Open Windows, excellent database link features, stable product with all standard spreadsheet features.

Does not implement a complete graphical interface, no fonts to choose from, weak presentation graphics, weak documentation.

Version: *2.4*
Systems: *Sun SPARCstation architecture running Open Windows and DEC VAXstation running DECWindows.*
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Price: *$1,800 per standalone SPARCstation. Concurrent use licensing will be released soon.*
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operate correctly with NumLock active. Access says it is looking into the situation with Sun.

For the time being, other 20/20 users will have to wait for a port of 20/20 RealTime–it only runs on the SPARCstation under Open Windows (and DEC VMS systems). Access is currently developing a Motif version, however, and it intends to port to other UNIX environments, as well.

Functionality First

Access put functionality first in developing a real-time product. But trying to package all 20/20 RealTime's features into one product, plus making it Open Look-compliant, produced a few noticeable compromises.

20/20 RealTime offers no real changes to fonts, graphics, and the like, leaving it trailing Wingz in the spreadsheet presentation market. And Access also displayed some interface wariness when it came to similarities with Lotus 1-2-3 (recall that Lotus likes to sue look-alikes). As a result, 20/20 has some strange interface devices, such as using the spacebar for the recalculation key, as well as poor use of the function keys.

The most visible change in 20/20 RealTime is the creation of an X Windows interface that runs under Open Windows 2.0 on the Sun SPARCstation. Because Access built the Open Look interface around a character-based product, certain items do not conform to the Open Look specification.

Take menu selection. Choosing the Menu button brings up a pulldown menu (as it should under Open Look), but subsequently picking a menu item puts you back into character-based land. In other words, when you select a menu item, a traditional 20/20 submenu–horizontal in fashion, with key accelerators–appears instead of another pulldown menu. This is palatable, but annoying for a GUI purist.

Another interface quirk–although one I liked–presents a row of on-screen buttons that imitate standard key assignments. For example, Menu (/), Calc (spacebar), and Edit (F2) are duplicated by Menu, Calc, and Edit buttons. And there's even a button for the Return key. If you like using a mouse and disparage moving between the mouse and keyboard, you'll like this quirk.

Access adds a third set of buttons near the bottom of the application window. Here, commonly used commands such as Copy and Format appear as a button to act as quick keys for commonly used functions. It's another play for mouse aficionados, and it addresses 20/20's shortage of function key-based quick keys.

Meaningful Real-Time Processing

The power behind 20/20 RealTime is real-time processing. There are several ways to define real-time processing. As defined by Access, it involves a one-way data feed from a data source into an application. Any output generated by the application uses a separate outgoing data feed. While 20/20 RealTime does not react in the millisecond range of true real-time systems, it pretty much responds within a second, giving it real enough capabilities for real-time spreadsheet markets.

Access Technology sees three primary markets for real-time analysis in a spreadsheet: financial (primarily on the trading floor), manufacturing, and laboratory/scientific analysis. Each of these fields is already deep into real-time applications, primarily in proprietary, fixed systems. Access hopes to use the flexibility of the spreadsheet, with its ease of use and broad acceptance, to make additional forays into the market.

Access has put together a robust real-time system. RealTime consists of four components: a set of user commands; a server driver called the IPCF that provides the link to a third-party server; a physical data server written by the data provider to allow access to the data feed; and a set of tools to administer the RealTime system.

20/20 RealTime also comes with a function writing library called OpenLink. OpenLink allows any developer to write functions that can access incoming real-time data. OpenLink is not a language like the Lotus Tool-Kit; rather, it's a specification for functions that can be written in C, Cobol, or Fortran.

The spreadsheet supports both multiple logical servers and multiple physical servers. Each spreadsheet application can handle any number of data feeds, as long as they are routed through a single physical server. Access Technology provides a demo server with source code that can be altered and used for an actual application.

Real-Time Example

Let's follow the data flow of a commodities trader dealing in precious metals. The trader needs constant information on gold, silver, platinum, and other metals on a real-time basis to keep up on the quickly changing market.

Market data consists of the price for each particular metal. Data is supplied over a third-party data feed, like those offered by Micrognosis or other systems integrators. The systems integrator will in most cases provide the user with a data dictionary outlining what fields are available on the feed. The integrator takes care of all the server/data feed issues, leaving you to worry about building the spreadsheet application.

The main purpose of your application is to display the prices and recalculate investment formulas based on price changes. Unlike most other real-time sheets, 20/20 goes beyond placing a single data element in a single cell. For starters, you create a scroll range for the data elements. In this case, the price of gold, silver, and platinum will not only display the most recent value, but also any number of past values, on the screen as the new data comes in. Five past values might be enough for normal trading analysis.

20/20 has more than just price fields.

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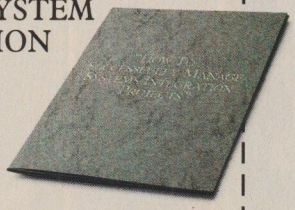

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You can add the time value associated with each price and a third field called an alert value. An alert is a message about what has happened to the real-time data. For example, it might say that gold has dropped 1/2 percent.

A trigger macro sets off your alert and searches the incoming feed to register differences. If there is an uptick in the field, a message is placed in the alert column. Trigger macros are built just like any other macro, using a new macro command to evaluate the information coming into a target cell and then reporting a user-created message. Alerts also print in the command bar across the top of the screen, bringing the data immediately to your attention.

Going even further, as the data fields change, 20/20 will highlight in different colors to indicate whether the incoming field is an increase or decrease from the previous price. As the price of gold drops on a moment-by-moment basis, the screen values reflect this with colored text.

Tools Galore

Access provides many standard features that help 20/20 penetrate the UNIX marketplace. For example, 20/20 provides a suite of audit tools, including a debug mode that locates circular references, tracks errors, shows all error cells, and allows corrections to be made. Additionally, a self-documentation command produces output to screen or printer of the cell display, location, and contents.

Database Connection is Access' integrated tool to link up with external data. 20/20's menu structure allows SQL queries to be created, run against the database, extract the data and place it in 20/20, all without the user knowing SQL or where the data is physically located.

Running on the SPARCstation, 20/20 RealTime is zippy and responsive. Windows redraw fairly quickly, and recalculations are fast. But once I opened five or six applications–including three different 20/20 spreadsheets–functions such as graphics were noticeably slower.

20/20 attempts to provide strong links to other spreadsheets, especially Lotus 1-2-3. It can read and write 1-2-3, Symphony, PC Excel and DIF files, so 20/20 is adequately flexible when dealing with the competition. A full chapter in the documentation discusses how 1-2-3 can work with 20/20, including information on command differences.

Documentation of the basic product remains unchanged from previous versions. In general, the documentation is thorough, but Access could have added more of a tutorial on real-time processing. The X Windows interface and RealTime module are both explained in two addenda to the manual. It's only an adequate approach, because the resulting documentation makes 20/20 more difficult to learn for the new user in a graphical environment.

Inevitable Comparisons

Comparisons to Wingz and 1-2-3 for Sun are inevitable. 20/20 has done a great job of finding a niche in-between these competitors. Wingz is more of a true GUI application with full mouse control, font selection, hyperscript programming language, and the lack of character-based baggage. But 20/20 is nearly as easy to use with the mouse, because all character commands respond to the mouse. 20/20 also is able to maintain compatibility with its installed base, while still reaching out to GUIs.

Lotus 1-2-3 for Sun does not attempt to use any of the GUI features under Open Look. It runs under SunView and utilizes SunView windows to display graphs and additional copies of the spreadsheet. This leaves you without direct mouse access or any of the Open Look functionality. 20/20 does a better job than Lotus of mixing a character-based application into a GUI, but this combination compromises you in the long run. Both Lotus and Access show interest in maintaining compatibility with their respective installed base.

As with any product, the bottom line is whether the benefits outweigh the investment of time and money. The answer depends on the application. In the arena of real-time analysis, such as financial trading and the manufacturing floor, 20/20 has no equal. The depth of the features, the efficiency of the integration, and the flexibility of the underlying spreadsheet result in a product that can handle tasks that were once impossible without massive amounts of programming. In this area, 20/20 is the real-time standard for measuring others.

In the more traditional spreadsheet environment, 20/20 under Open Windows cuts a fine line between character-based and full-blown GUIs. If you need strong presentation graphics and complete font control, choose Wingz. But in nearly all other functions, 20/20 displays excellent skills in tying the world of mice and buttons into a character-based product and producing an easy-to-use, fully functional application for real-time needs. □

Mike Burgard is a freelance writer and information manager at a commercial printing company in Montana.

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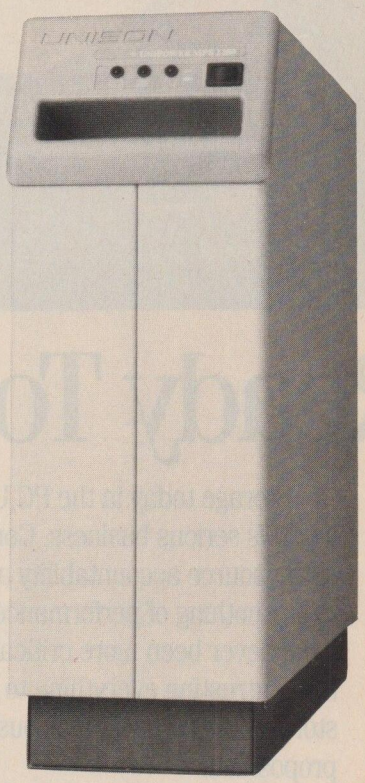

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CIRCLE NO. 252 ON INQUIRY CARD

BACKING UP WITH BRU

By Tom Yager

Making backups is never fun, but at least BRU makes it easy

Enhanced Software Technologies Inc. believes the growing UNIX business market wants smart system administration tools. Its Backup and Restore Utility–unobtrusively named BRU–offers some diverse capabilities that could only be obtained with a combination of **grep**, **diff**, **du**, **cpio**, **find**, and **compress**. But unlike these tools, BRU is tailor-made for managing the reliable and efficient backup and restoration of data.

BRU blends well with UNIX, sporting a command-line interface that has enough in common with **tar** ("c" to create, "x" to extract, and so on) to make the switch easy. The transition is made easier by BRU's extensive additional options, most of which enable features that make **tar** look wimpy by comparison. BRU has its own built-in help, and ships with detailed **man** pages. Versions for 386 systems also have a new menu-driven interface.

Although BRU uses a proprietary data format, tapes made with it are exchangeable among other systems that run BRU. That list is lengthy, starting with several BSD and System V systems, and it includes some surprises as diverse as Silicon Graphics systems and the Commodore Amiga. Those who can't get a binary version of BRU can purchase it in source-code form and port it themselves (in most cases, this is accomplished by simply typing **make** and letting it compile).

BRU was tested on a pair of computers: an Altos System 5000 APS with 16 megabytes of memory, a 25-MHz 486 processor, and a 525-megabyte SCSI tape drive; and a Siva 386/20 from VNS America

BRU Backs Up Better

BRU performs critical backup tasks faster than the UNIX system utilities, cpio and tar. The following table shows the performance of BRU, cpio, and tar on an Altos 486 and VNS 386 system. The table also shows how long it took for BRU to verify backup integrity (at the fastest possible speed).

Altos 486/25

Operation	*Buffer Size*	*Software*	*Megabytes/ minute*
Verify integrity	Not applicable	BRU	5.59
Create archive	512K (double buffer)	BRU	4.60
	512K	BRU	4.34
	512K	cpio	3.42
	512K	tar	4.07
Extract files	512K (double buffer)	BRU	5.34
	512K	BRU	4.99
	512K	cpio	3.66
	512K	tar	5.58

VNS 386/20

Operation	*Buffer Size*	*Software*	*Megabytes/ minute*
Verify integrity	Not applicable	BRU	4.26
Create archive	200K (double buffer)	BRU	1.58
	200K	BRU	3.90
	200K	cpio	3.87
	20K	tar	3.95
Extract	200K (double buffer)	BRU	1.83
	200K	BRU	3.31
	200K	cpio	3.51
	20K	tar	3.53

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with 8 megabytes of memory and a 125-megabyte Archive ST600-SS tape drive with a proprietary controller. The Altos ran Altos System V (SCO UNIX 3.2 with enhancements), and the VNS used Interactive Systems' 386/ix version 2.0.2.

Competing products to BRU are numerous. Like BRU, they have been spawned by small companies. Of the pack, Ctar from Med-Flex (Myrtle Beach, S.C.), Lone Tar from Lone Star Computing (Mount Airy, Md.), and Ubackup from Unitech Software (Reston, Va.), are some of the more notable ones. BRU addresses many of the issues facing these other packages, but falls short of Lone Tar in the area of exclusion lists (which BRU does not support). A companion product, BRU-Menus, adds a full-screen interface to BRU and also provides for exclusion lists (and more robust selection of files for backup and extraction in general).

Sensible Options

At first glance, BRU appears to be only a slide-in replacement for the likes of `tar`. Simple, sensibly chosen options determine the direction of data flow to and from the disk, and configure various parameters such as buffer size and output device. Digging deeper, it quickly becomes obvious that BRU is really a backup *system*, with options geared toward the demands of large-scale archival storage.

The reference base for BRU is the `brutab` file. There can be several (the current one is pointed to by the BRUTAB environment variable). Each contains a description of the backup devices available, the storage capacity of each, the default buffer size, any variances in the error codes (some tape device drivers have different ways of signaling "end of tape" or "write protected"), and other options related to double-buffering.

The basic commands available to the BRU user extend far beyond the requisite `create` and `extract`. Before any data is written to tape, the `-e` option can be used to get an estimate of the amount of data to be backed up, and the number of tapes (or other media) required for the process. After you create an archive, its table of contents can be read with `-t`, its integrity checked (simple read-back) with `-i` (for "inspect"), and its contents compared to disk with `-d`.

The actions taken by these functions are modified by 25 additional options, which carry reasonable defaults when omitted. The most interesting is `-D`, which turns on double-buffering. BRU's double-buffering splits BRU into two processes, one read and one write. With this scheme, some systems can achieve significant performance gains by working simultaneously with disk and tape. (Some hardware designs limit double-buffering's effectiveness, a weakness BRU readily admits, and one borne out by my performance tests. See table.)

Frequent Backups

BRU also has built-in LZW data compression (the same used in the popular UNIX `compress` utility), on average shaving up to 35 percent off the size of stored data. This is useful for those businesses that require frequent backups, because the total number of tapes can be reduced. As with all data compression, BRU's method consumes extra CPU and disk space. It can also make the entire backup process take longer.

One system administration annoyance that BRU counteracts is the necessity of dismounting local and NFS or RFS network file systems to isolate specific areas for backup. BRU has two options that instruct the program not to cross local mount points, and not to include network-mounted file systems in the backup. These both make it much easier to per-

REVIEW HIGHLIGHTS

BRU
Enhanced Software Technologies Inc.
5032 S. Ash Ave., Ste. 107
Tempe, AZ 85282
602-820-0042

Handles multiple volumes; includes advanced error recovery; can be tuned to exploit hardware for maximum performance.

Can't specify file exclusion list.

Version: *11.13.*
Systems: *Several BSD and System V UNIX systems, Commodore Amiga, others. Source code is available*
Licensing: *Per CPU.*
Price: *$299 for 386 systems; $199 for 286 systems; source license only for other platforms.*
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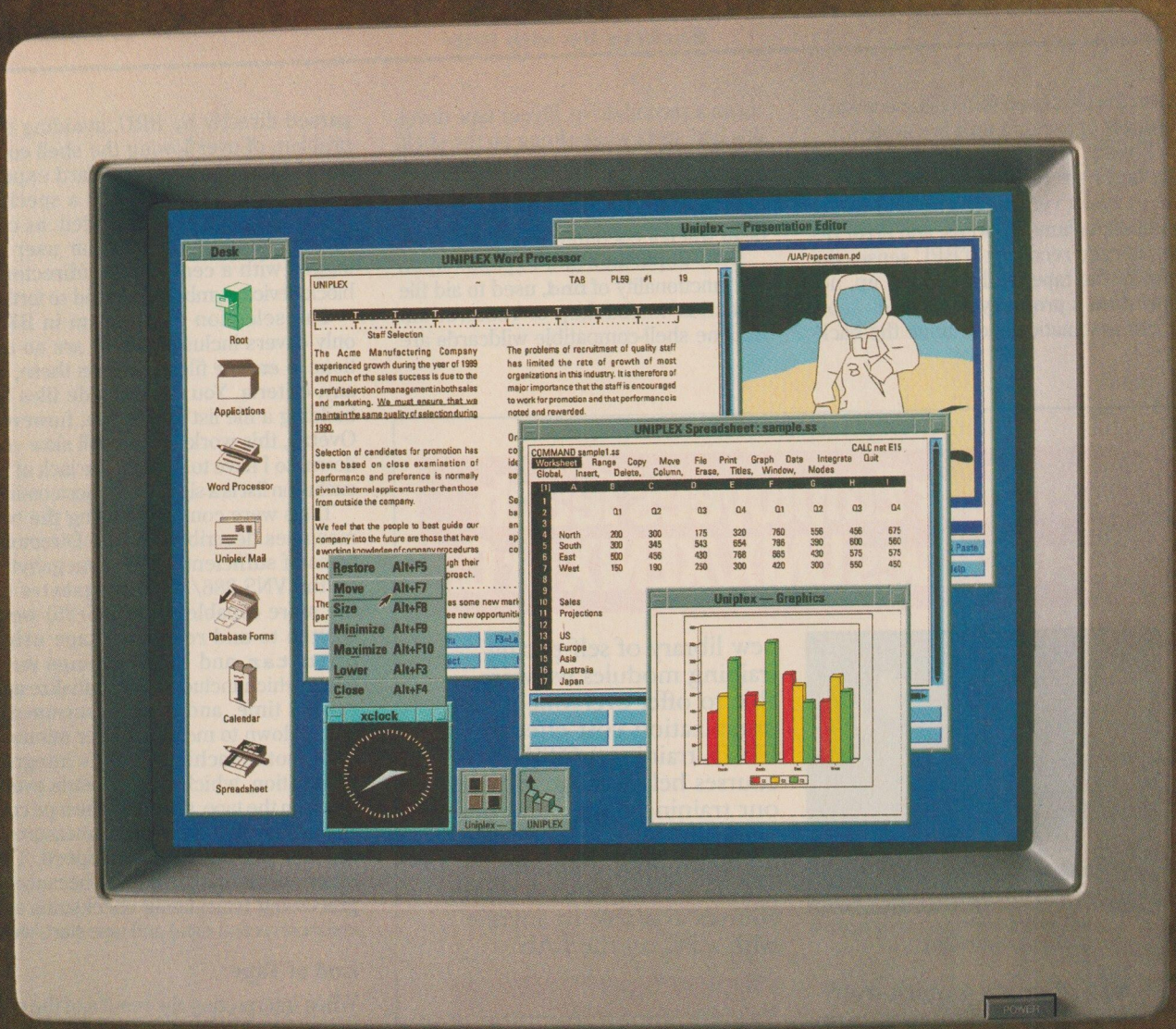

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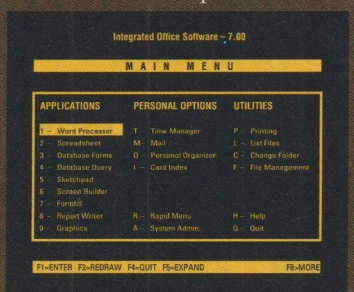

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form the ill-advised (but often necessary) process of backing up a live system.

Finally, BRU's most significant advantages are two functions that should be in every version of **tar** and **cpio**: multiple volume backups, and error detection and recovery. If BRU senses the end of the tape while backing up, not only does it prompt you for a new tape, it can automatically continue the backup on a second drive. If your tape develops bad spots while sitting on the shelf, BRU logs the error, skips over the damaged file(s), and attempts to continue the extraction. Conversely, **tar** stops dead when it encounters an error.

BRU duplicates and expands upon the functionality of **find**, used to aid file selection for backup or restoration. Bourne shell-compatible wildcards are parsed directly by BRU, avoiding the problem of overflowing the shell command line with huge wildcard expansions. Files modified since a specific date and time can be included, as can those owned by a particular user or tagged with a certain type (directory, block device, symbolic link, and so forth).

The selection mechanism in BRU only covers inclusion; there are no options to *exclude* files based on these, or any, criteria. You can exclude files by building a file list in advance, however. Overall, this work-around will slow you down, so I have to say that the lack of an exclusion list is a significant shortcoming.

Tests were conducted using the two machines described earlier. Directory trees of sufficient size (17 megabytes on the VNS 386/20, 33 megabytes on the more capable Altos 486/25) were written to and read from tape using **cpio**, **tar**, and BRU. Timings were taken which included tape initialize and rewind time, and the measurements boiled down to megabytes per minute.

On both machines, BRU's integrity verification, which simply reads every block on the tape, streamed the tape constantly. It is, therefore, a fair measure of the tape drive's maximum speed. The other operations are slower because of processing (calculating checksums and error-correction data) and tape start/stop.

End of Tape

When interpreting the results of the performance table, keep in mind that BRU is not in the same class as **tar** and **cpio**. If nothing else, its error-recovery methods alone put its predecessors to shame. Its wealth of options allow the administrator to tune BRU to run at maximum efficiency on a variety of systems. It took me less than an hour to get the two test systems moving data as fast as possible.

Once tuned, BRU delivers its extra functionality and reliability with very little cost in time and effort. Considering it is taking the time to calculate and write error-correcting codes, BRU performs remarkably well. As the table shows, even when the traditional utilities are faster, it's by such a narrow margin that BRU's data recovery keeps it on top.

While it's fun to find unique and witty ways to solve problems using the standard UNIX tools, backup is probably not a good place to experiment. BRU is stable and versatile, a well-rounded UNIX backup utility. □

Tom Yager is a freelance writer who specializes in graphics and networking software, as well as workstation and multiuser platforms.

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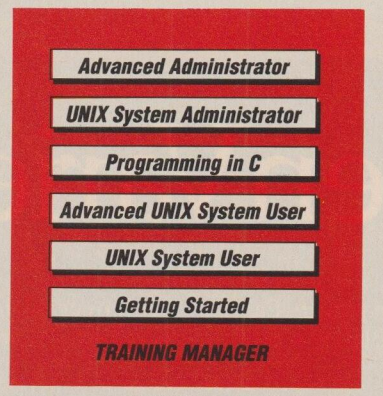

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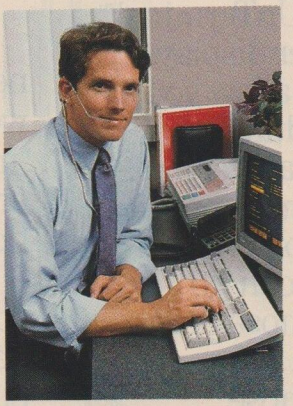

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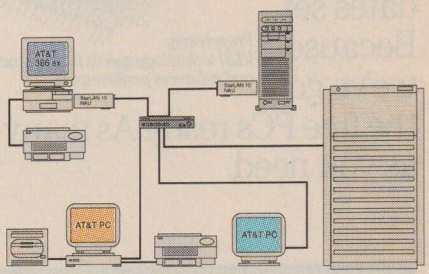

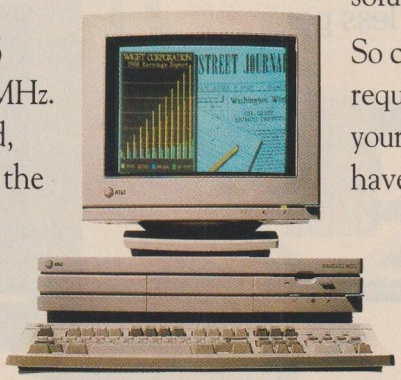

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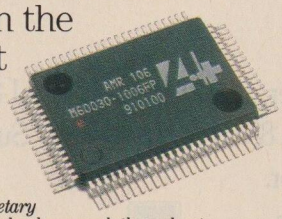

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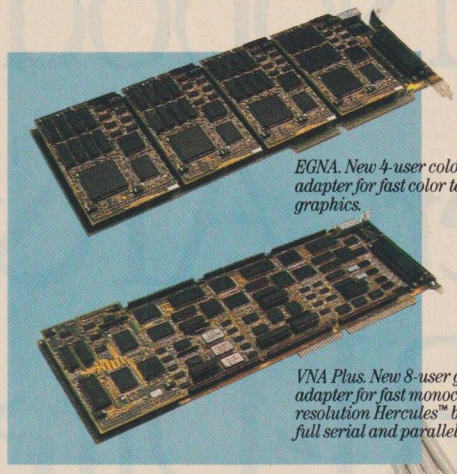

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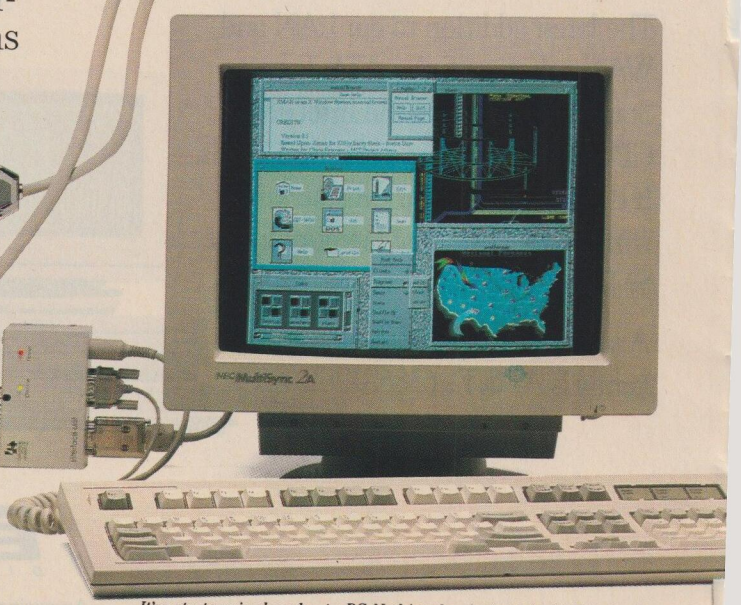

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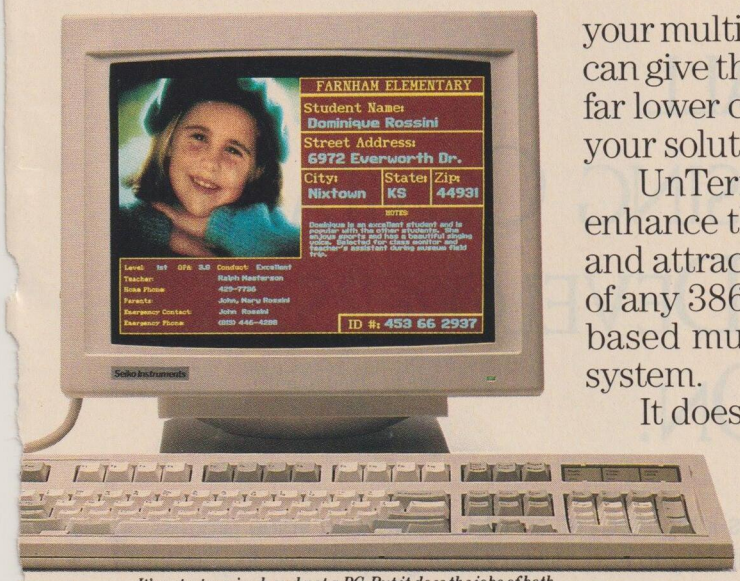

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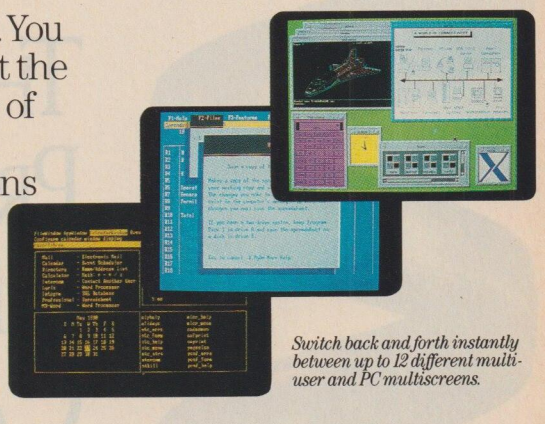

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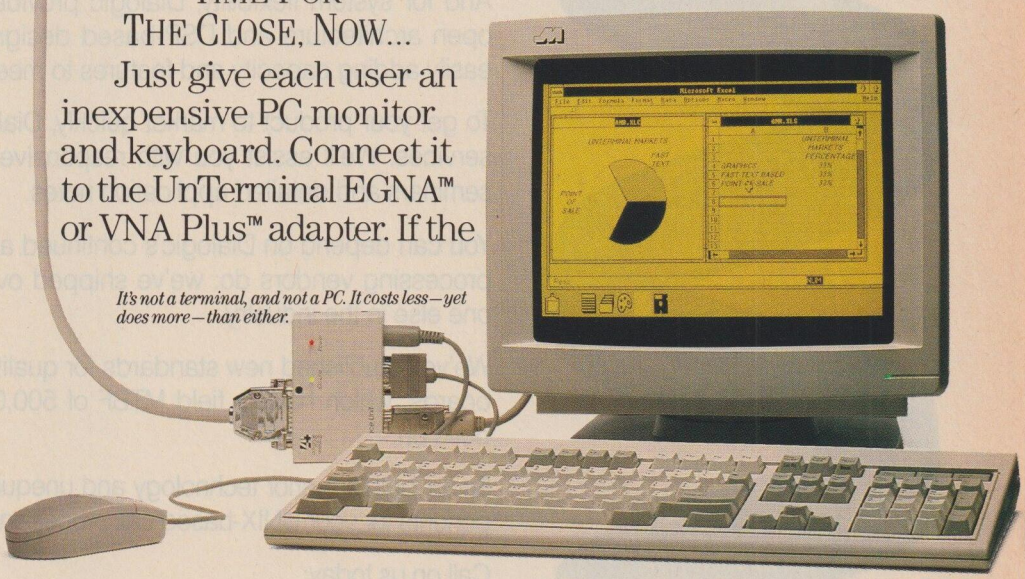

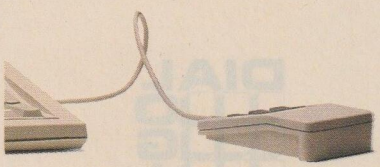

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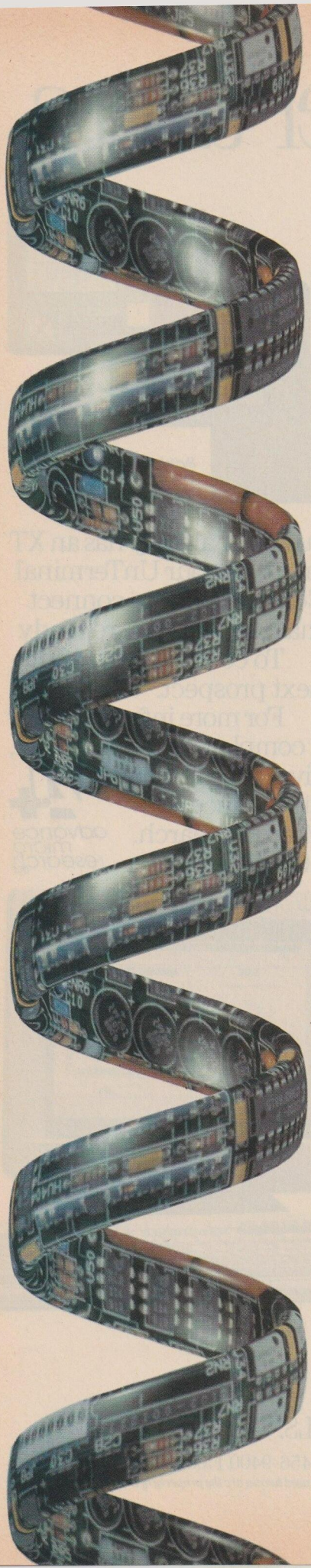

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THE NAME BEHIND THE VOICE

CIRCLE NO. 119 ON INQUIRY CARD

Update by Frank Hayes

How Posix Is Redefining UNIX

The definition of "open systems" is changing. An unusual alignment of official standards organizations is determining the shape for a new, standardized UNIX or, more accurately, a standard UNIX-compatible operating system–Posix. Over the next few years, that consensus will turn our view of portable, scalable, interoperable open systems inside-out–creating a new range of alternatives and competitors to UNIX.

But Posix–the IEEE's long-time project for specifying a UNIX-like portable operating system–has turned out to be a bigger and more complex project than its backers anticipated. And though several important parts of Posix are already being voted on, conflicting philosophies and practical problems are slowing its sprint through the standardization process.

Defining Posix

Originally, Posix was a project of the IEEE Computer Society to define external specifications for UNIX. The federal government and many computer vendors were particularly interested in the Posix project, because it promised to allow companies and federal agencies to specify UNIX-based computer systems without naming UNIX (which is a product of a single company, AT&T).

But in the last few years, the IEEE's Posix work has been endorsed and adopted by both the American National Standards Institute (ANSI) and the National Institute for Standards and Technology (NIST). ANSI is the designated national standards organization for the U.S., and represents the U.S. in international standards organizations such as ISO. ANSI has officially farmed out the responsibility for developing this set of open-system standards to the IEEE Posix committees, thus guaranteeing the smoothest possible ride for Posix through both national and international standards organizations.

But in some respects, NIST's endorsement of Posix is even more important than ANSI's. NIST is the agency of the U.S. Department of Commerce charged with setting standards for government computer purchases. NIST does this by issuing Federal Information Processing Standards (FIPS). ANSI standards are voluntary, but federal agencies are required to consider a FIPS when they're purchasing computer systems. This affects not only government agencies, but also the private companies that do business with those agencies. As a result, the Posix work being done today will set widely adopted standards for computing for decades to come.

Work of the Posix committees is expanding so fast that some institutional committee representatives fear it's moving too fast.

The NIST endorsement puts new pressure on the Posix committees to produce work as quickly as possible. In fact, some drafts of Posix standards have already been specified by NIST as FIPS, even before they've completed the balloting process. By the end of 1990, NIST plans to establish accredited Posix testing laboratories for testing Posix-compliant computer systems. And work of the Posix committees is expanding–so fast, in fact, that some of the institutional representatives on those committees are afraid it's moving too fast.

Some parts of Posix are already well on their way to becoming standards. For example, the central Posix document is the draft being produced by the IEEE 1003.0 committee, officially titled, "A Guide to Posix-Based Open Systems." The Guide sets the guidelines for the rest of the work of the Posix committees. After nine drafts, it's ready for a mock ballot–the last major step before a full vote on the standard.

While the Guide moves toward balloting, drafts from several other 1003 working groups are well on their way through the balloting process. 1003.2, the draft specifications for the shell and utilities, has already seen one round of balloting. Most of the objections to that draft required clarifying the draft's language, rather than technical changes; a new draft is once again being voted on. The same committee is also in the balloting process for the User Portability Extension (1003.2a), which will continue through mid-1991. That document has also been forwarded to ISO for review and comment at the international level.

The committee working on test methods for Posix, 1003.3, expects to have completed balloting for its document on general test methods by the end of this year; a separate specification, for testing compliance with 1003.1 (System Services), should have balloting completed by early 1991. (Those testing standards are essential for the testing laboratories that NIST plans to establish by the end of this year.)

The specifications of language bindings for C (1003.1), Fortran (1003.9), and Ada (1003.5) are in various stages of balloting. So is the document on real-time extensions (1003.4). The document on security (1003.6) is expected to go to formal ballot early next year.

Real-Time Problems

But despite the number of documents that have already begun balloting, significant problems have begun to appear in the world of Posix. At least one draft that has already reached the balloting stage in the U.S. won't be accepted in its present form by the international standards committees. The document on real-

time extensions has stalled at the international level because the specifications are not independent of a particular programming language.

How can a standard that hasn't yet been approved at the local level already be in trouble with international committees? Paradoxically, it's because everyone involved–at IEEE, ANSI, and ISO–wants Posix to move through the standards process as smoothly as possible. To avoid potential problems and surprises late in the process, Posix drafts are forwarded to ISO committees for review and comment as soon as they seem to be in workable form.

That's critical for smooth sailing because of the difference between national and international standards processes. International committees don't meet as frequently as the IEEE's working groups do. That can make the approval pipeline take much longer if there are major problems with a draft standard that's submitted to ISO–which can set a standard far behind schedule.

In the case of the real-time extensions document, the draft standard is already in the balloting process for IEEE. Once that's complete, the draft standard will have to be revised into language-independent form, and the new version returned to ISO for review and comment–and voted on again by IEEE members. Those revisions could create a delay of up to two years in moving this document to the international level.

Too Much? Too Fast?

And keeping track of the requirements of international standards bodies is only one problem the Posix committees face. Just coordinating the work of all the working groups and projects (at last count, 20 working groups and 29 separate projects) becomes increasingly complex as more documents are completed. Each substantial change to any document can affect others–a fine-tuning process that, without care, could end in requiring cascading waves of reballoting.

Meanwhile, even more Posix projects are being proposed. That has some committee members and representatives of large corporations such as IBM and AT&T concerned that the IEEE has bitten off more than it can chew.

Ordinarily, standards are relatively independent of one another, and move at a slow but steady pace through their committees. But Posix is a large collection of interrelated standards–a far more complex project than the norm. In addition, with Posix's endorsement by NIST, there's increased pressure for quicker development of the standards.

Concerns about the Posix workload fall into two categories. First is concern that there simply aren't enough people available to work on the committees. Committee members are volunteers, working on their own time or on loan from their companies. The committee work is time-consuming, and traveling to committee meetings is expensive–and there are a limited number of people both qualified and willing to take on the work.

An equally serious consideration–but one more tinged with politics and philosophical differences–is the concern that the Posix committees are trying to standardize too much. Some observers believe it's not appropriate for the Posix committees to set standards for areas such as system administration. They argue that there's not enough real, consistent experience in those areas to create a workable standard.

In part it's a fight over philosophy, between those who believe in setting broad standards and minimalists who want as few standards as possible. But the significance of the debate is magnified because Posix stands to see such widespread use.

Not only UNIX-like systems, but even proprietary operating systems could soon be competing with UNIX as open systems.

In the face of these concerns, the Sponsor Executive Committee (SEC) of the IEEE's Technical Committee on Operating Systems has set new guidelines for Posix projects. The guidelines include requirements that (1) enough of the industry is interested in the project, willing to work on the committee, and ready to use the standard when it's complete; (2) there's enough industry experience to set a standard; and (3) the work will merge well with the Posix projects already under way.

The guidelines won't only affect new projects, either. As soon as they were implemented, the SEC decided to put a proposed project on User Interface Management Systems on hold. And in light of the guidelines, IEEE has reshuffled several existing projects and reorganized its numbering system for working groups.

Open Systems Without UNIX?

Posix was originally intended to be a generic, non-brand-name specification for UNIX. So thanks to the Posix standardization work, UNIX–real UNIX, the product of AT&T's Bell Labs–is guaranteed to become, at least for the moment, the preeminent Posix-compliant operating system. But a less obvious result is that UNIX will face plenty of new competition in the open-systems arena.

For two decades since it was originally developed at AT&T's Bell Laboratories, UNIX has had a simple definition: If the source code is from AT&T, it's UNIX. True, there have been offshoots such as the Berkeley Software Distribution (BSD) version and the most popular PC variation, The Santa Cruz Operation's XENIX, along with a fistful of brand-name UNIX versions from DEC, Sun, HP, IBM, and others, and even re-architected variations such as Mach. But all are based on AT&T source code–even such strident AT&T competitors as the Open Software Foundation's OSF/1. And because AT&T controlled the definition of UNIX, it was impractical for any competitor to try rewriting that AT&T code, because by changing the definition for a new version, AT&T could make any UNIX clone instantly incompatible.

But Posix is defined as a set of interfaces and functions for the parts of the operating system, rather than by its internal operation–from the outside in, rather than from the inside out. The Posix committees are creating an open-systems standard that's independent of AT&T code or any other internal similarity to UNIX.

As a result, not only UNIX-like systems, but even proprietary operating systems could soon be competing with UNIX as open systems. Several vendors already say they'll make their proprietary operating systems Posix-compliant to guarantee that they'll make the cut in bidding for government contracts. What will it mean when proprietary systems can actually offer a standards-based claim to the portability, scalability, and interoperability that's always been UNIX's forte? It's unlikely to mean the end of UNIX–but it may be the start of a new generation of open systems. □

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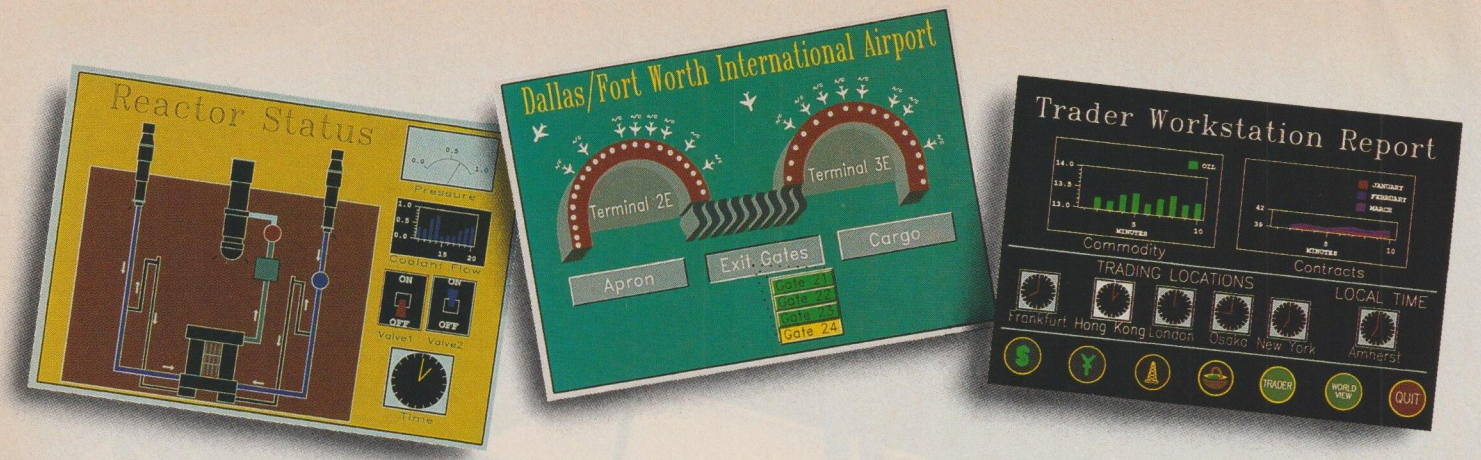

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USING MOTIF'S USER INTERFACE LANGUAGE

You can separate user interface design from the confines of a C program for faster prototyping and easier customization

By Ken Flowers

Ken Flowers is a documentation engineer at the Open Software Foundation. He is currently working on the latest version of OSF/Motif documentation, including the *OSF/Motif Style Guide*.

Last month's tutorial introduced programming with the OSF/Motif Toolkit and used a simple text entry program as an illustration. This month's tutorial describes how to use the OSF/Motif User Interface Language (UIL) to create the same example program, showing the parallels and differences between the two methods.

UIL does not replace the OSF/Motif Toolkit; it simply provides a different interface to the Toolkit that makes certain tasks easier to perform. Using UIL to design a user interface for OSF/Motif offers the following advantages:

Separation of form and function. The general concept of UIL is to place the description of the user interface outside of the code that implements it. This separation allows multiple programs to read in the same user interface description if they have a similar user interface. And, one program could read in different user interface descriptions possibly because of culture, language, or a user's preference. Separating the form and function also allows a user interface designer to work independent of the program algorithms used by the application designer. In such an environment the user interface designer would not need to learn C in order to code the user interface.

Easier customization. Because the information in a UIL file is read by the C program when it is executed, the program can choose a different user interface by specifying a different UIL file at run time. A common use for this feature is to read in a different localized user interface version based on the native language of the person using the program. Even the layout of the user interface could be altered based on cultural preferences, such as the direction of printing.

Faster prototyping. Once a C program compiles correctly for use with a UIL file, there is usually no need to recompile it again for minor changes in the user interface. A UIL file compiles in a fraction of the time of a C program, and the resulting User Interface Definition (UID) file can be easily reread by the C program. This feature makes simple alterations, like changing the text of a message, less of a chore.

Earlier error detection. The UIL compiler verifies that the user interface design is correct before you spend time compiling and running the C program. The UIL compiler checks that the user interface elements you specify are allowed to connect in the way you defined. It also verifies that all the resources you specify for a control are valid and that they have values of the right type. These are the kinds of errors that are not easily caught using a C compiler.

Easier coding. Coding is not only easier because of the separation of form and function, but also because the UIL file syntax is not bound to the syntax of C functions and this file allows forward referencing of user interface objects. (The object's children do not need to be defined before they are associated with the object.) Objects are declared by name and their resources, callback routines, and children are listed with the definition of the object.

The steps for building a user interface using UIL are not very different from building a user interface using only the OSF/Motif Toolkit:

- Design the application's user interface
- Build the UIL file
- Compile the UIL file
- Initialize the application program

continued

- Include the user interface in the program
- Integrate the application's algorithms
- Compile, test, and debug the application

This tutorial builds on the concepts presented in last month's tutorial on the OSF/Motif Toolkit and on the three-part tutorial series on the X Window System by Doug Young (January through March 1990). That series described the X Toolkit and Xt Intrinsics, and such concepts as widgets, event handling, callbacks, and resources. This article assumes you have read these tutorials or have equivalent background.

Design the Application's User Interface

The user interface design step does not depend on whether or not you use the UIL in conjunction with the Toolkit. As described in last month's tutorial, you should define what your application should do, choose the best control for each feature, and position the controls on the workspace. Last month we designed a user interface for a simple text entry area with the following characteristics:

- An area for entering text
- An initial content of "Text entry area"
- A means for changing the text
- A means for clearing the text
- A means for resetting the initial contents
- A means for exiting the application

We will use the same example in this tutorial to illustrate UIL. The application hierarchy for our text entry area is shown in Figure 1.

Build the UIL file

A UIL file starts with a `module` clause that names the UIL module and ends with an `end module` clause. These are shown at the top and bottom of Listing 1 for our example program. Between these two clauses you define the contents of the UIL file, which can include a version number, default character set, include directives, and clauses for defining procedures, lists, and objects. You can also set values that can be read by the C program at execution time including most standard value types, compound strings, translation tables, colors, and pixmaps. Thus, you can change many characteristics of an application without recompiling the C program, which is especially useful for an application like defining message catalogs.

FIGURE 1: A widget hierarchy diagram can help you conceptualize the application as you write the code. This figure shows the widget hierarchy for our simple text-editing example.

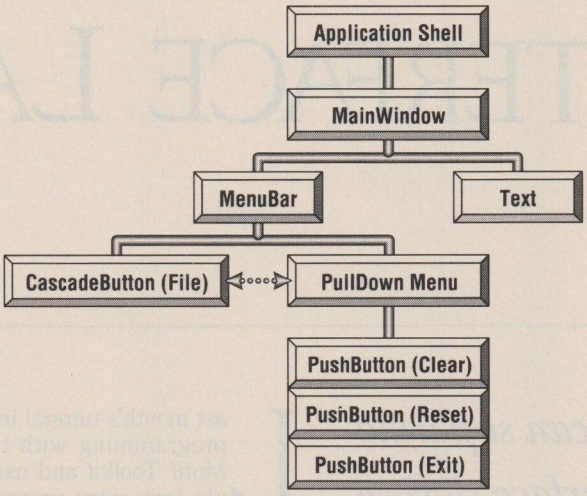
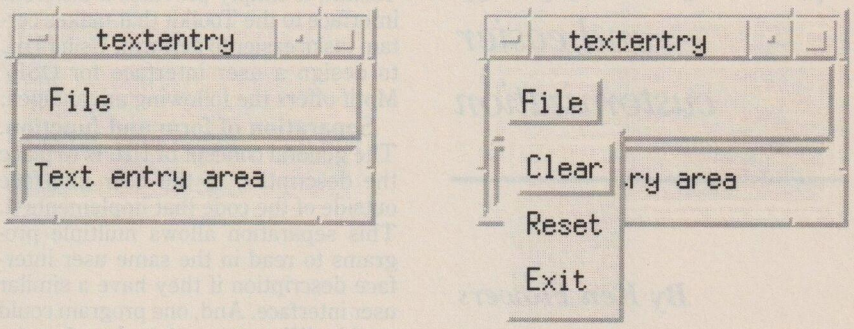


FIGURE 2: The completed application produces the displays depicted in the two parts of this figure. The first part shows how the screen appears after the program is invoked and the second shows the appearance after the File Menu has been posted.



In this article we describe how a UIL file is used to specify a widget hierarchy and its callback routines. Widgets are defined as objects that can be referenced by name and callbacks are defined as procedures in the UIL file. The syntax for object and procedure clauses is shown in Listing 2. White space is only used in the syntax to separate elements; you can use tabs, spaces, and newlines interchangeably in the actual UIL file.

The keywords `object` and `procedure` indicate the start of an object or procedure clause. Once started, you can define as many objects or procedures as you like without reusing the keyword. Also, the order of clauses and the organization of objects and procedures is not important because the UIL compiler resolves most forward references. Single-line comments can be introduced by an exclamation point (`!`) and terminate at the end of the source line. Conventional C language comment delimiters (`/* */`) are also recognized.

A procedure clause contains any number of procedure definitions. You must declare a procedure for every callback, which allows the UIL compiler to do the proper type checking on the procedures and their arguments. A procedure declaration consists of a procedure name and an indication of the data type of the procedure's argument, if it has one. This argument is passed to the callback routine in its

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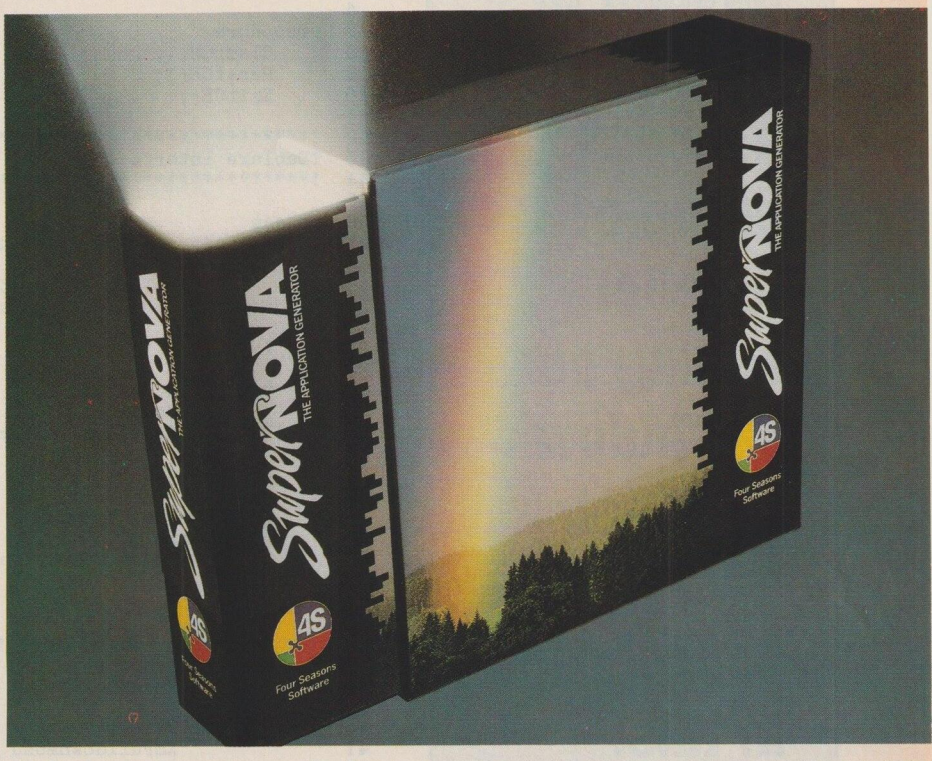

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LISTING 1: Our `uiltext` example program provides the same features as last month's `textentry` example program, but is built using UIL. Here is the UIL file for the `uiltext` example program:

```
 1  module uiltext
 2
 3  !*************************
 4  !Declare callback procedures
 5  !*************************
 6
 7  procedure
 8      ClearCB();
 9      ResetCB();
10      ExitCB();
11
12  !*************************
13  !Declare interface objects
14  !*************************
15
16  object
17      uiltextmain: XmMainWindow {
18          controls {
19              XmText      text_area;
20              XmMenuBar   menu_system;
21          };
22      };
23
24      text_area: XmText {
25          arguments {
26              XmNvalue = "Text entry area";
27          };
28      };
29
30      menu_system: XmMenuBar {
31          controls {
32              XmCascadeButton file_menu;
33          };
34      };
35
36      file_menu: XmCascadeButton {
37          arguments {
38              XmNlabelString = "File";
39          };
40          controls {
41              XmPulldownMenu {
42                  controls {
43                      XmPushButton clr_button;
44                      XmPushButton rst_button;
45                      XmPushButton exit_button;
46                  };
47              };
48          };
49      };
50
51      clr_button: XmPushButton {
52          arguments {
53              XmNlabelString = "Clear";
54          };
55          callbacks {
56              XmNactivateCallback = procedure ClearCB();
57          };
58      };
59
```

continued

client_data argument. If the procedure definition does not include parentheses, no type checking is done on the argument. If the parentheses are included with no argument type, the procedure must not take arguments. If the type of an argument is included, the value of the argument in the callback must match that type.

Now let's discuss the UIL file in Listing 1. The procedure clause encompasses lines 7 through 10. These procedures are used by the activation callbacks of the PushButtons in the File Menu and are defined in the C program (Listing 3).

The object clause is the backbone of the UIL file; the application hierarchy, its resources, and callback routines are defined in this clause. An object clause is made up of one or more object definitions. An object is defined by a name, type, and set of characteristics: arguments, controls, and callbacks. The argument list defines the resources for the object, which are the

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same as those used in the OSF/Motif Toolkit. You only need to specify resource arguments where the default values are not acceptable. The controls list defines the child objects of the parent objects. These can reference another object definition or define an unnamed object directly. The callbacks list defines the callback procedures for the object. These are defined as resources in the OSF/Motif Toolkit and are listed like arguments in the UIL file.

The object clause for our example begins on line 16 of Listing 1. It starts out by defining the MainWindow widget of our application. (The Application Shell widget is defined in the C program when the X Toolkit is initialized.) The name of the MainWindow is `uiltextmain`. The MainWindow object definition only includes a controls list that contains references to the object definitions for the Text widget and the MenuBar widget.

The next object defined is the Text widget named `text_area`. The Text widget has an arguments list that sets the value of the `XmNvalue` resource

Listing 1 continued

```
60      rst_button: XmPushButton {
61          arguments {
62              XmNlabelString = "Reset";
63          };
64          callbacks {
65              XmNactivateCallback = procedure ResetCB();
66          };
67      };
68
69      exit_button: XmPushButton {
70          arguments {
71              XmNlabelString = "Exit";
72          };
73          callbacks {
74              XmNactivateCallback = procedure ExitCB();
75          };
76      };
77
78  end module;
```

LISTING 2: The body of a UIL file is composed of declaration blocks for (among other things) setting values, defining procedures, lists and objects, and including other UIL files. Here is a listing of the syntax for the procedure and object blocks, which are used in our sample program.

A. A procedure declaration in a UIL module defines routines that are used as callbacks. This allows the UIL compiler to do proper error checking.

```
procedure
    procedure_name [([argument_type])]
```

continued

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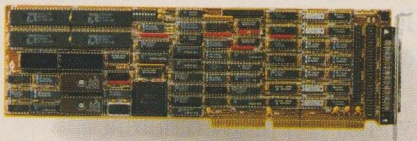

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to "Text entry area," which will be the initial content of the Text widget. The Text widget has no controls or callbacks.

The MenuBar object defines only one child object, the File Menu CascadeButton. The CascadeButton widget is labeled with the word "File" in the argument list, and is given a single child in the controls list. That child, a PulldownMenu, is defined directly in the controls list without a name. The PulldownMenu is itself given the three PushButton controls, which are defined with an argument list that sets their labels and a callback list that sets their activation callbacks.

Note that in our UIL file example, objects are defined with forward references to their children. This order is not enforced, but makes the file much easier to read. Using only the OSF/Motif Toolkit you must define children with backward references to their parents.

Listing 2 continued

B. An object declaration is the basic building block of a UIL file. It can contain arguments, controls, and callbacks. The controls section can either list controls by reference or define new objects.

```
object
    object_name : object_type {
        arguments {
            resource = value
        };
        controls {
! object declared by reference
            object_type object_name
! new object declaration
            object_type {
! arguments, controls and callbacks to define unnamed object
            }:
    };
   callbacks {
        callback_resource = procedure procedure_name [([client_data])];
    };
};
```

Compile the UIL file

A UIL file is compiled so the OSF/Motif Resource Manager (MRM) has quicker access to the user interface information. MRM is the C functional interface that reads the UID file and sets up the OSF/Motif Toolkit structures for the user interface. You compile the UIL file with the `uil` command, which has a syntax (see Listing 4A) very similar to `cc` and recognizes several options. Some of the more useful options include: `-o`*filename* creates a UID file named *filename* instead of the default, `a.uid`; `-v`*filename* directs `uil` to produce a listings file, *filename*,

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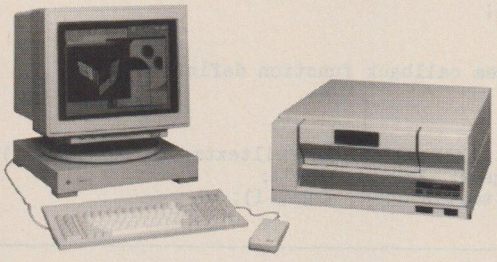

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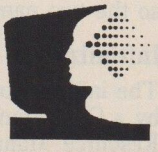

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LISTING 3: Once the UIL file has been compiled into a UID file it can be read in by any C program using the OSF/Motif Resource Manager. There is no need to recompile the C program if the UIL file is modified and recompiled. Here is the C code that reads the UID file for our `uiltext` example program:

```
#include <X11/Intrinsic.h>
#include <Mrm/MrmPublic.h>
#include <Xm/Xm.h>

MrmHierarchy    s_MrmHierarchy; /* declare uid variable */
static char     *vec[]={"uiltext.uid"}; /* declare uid hierarchy */
MrmCode         class; /* dummy variable */

void ClearCB(), ResetCB(), ExitCB();  /* declare callbacks */
Widget text_widget, uiltextmain;  /* declare file scope variable */

static MrmCount         regnum = 3; /* declare number of callbacks */
static MrmRegisterArg   regvec[] = { /* initialize callbacks list */
     {"ClearCB",(caddr_t)ClearCB},
     {"ResetCB",(caddr_t)ResetCB},
     {"ExitCB",(caddr_t)ExitCB}
     };

void main(argc,argv)
unsigned int argc; char **argv;
{
    Widget application;
    Arg args[10]; register int n;
/* Initialize the resource manager */
    MrmInitialize();
/* Initialize the Intrinsics, creating top-level shell widget: */
    application = XtInitialize ("main", "Text Demo",
                                NULL, NULL, &argc, argv);

/* Open the uid hierarchy */
    MrmOpenHierarchy (1, vec, NULL, &s_MrmHierarchy);
/* Register the callbacks in the uil file */
    MrmRegisterNames (regvec, regnum);
/* Get the widget tree from the uid hierarchy */
    MrmFetchWidget (s_MrmHierarchy, "uiltextmain",
                    application, &uiltextmain, &class);

/* Manage the widget tree */
    XtManageChild(uiltextmain);

/* Realize all widgets and enter the event loop: */
    XtRealizeWidget(application);
    XtMainLoop();
}

/* Clear text area callback function definition: */
void ClearCB()
{
    Arg args[1];
    text_widget = XtNameToWidget(uiltextmain,"text_area");
    XtSetArg(args[0], XmNvalue, "");
    XtSetValues(text_widget, args, 1);
}
```

continued

which contains source lines of the input and header files, diagnostic messages, and a summary of files read; and `-I`*pathname*, which tells the compiler to search the *pathname* directory for header files.

Listing 4B shows the command line for compiling our UIL file, `uiltext.uil` to give a UID file named `uiltext.uid`. This name is used literally in our example C code, so the two names must be the same.

Initialize The Application Program

The information in a UID file is read by a C program using the OSF/Motif Resource Manager (MRM) facilities. MRM has functions that do such things as fetch values, build user interface hierarchies, and register callback names. Besides the normal C and OSF/Motif initialization procedures (including the necessary header files, declaring any functions and variables, and initializing the X Window System Toolkit), you must also initialize the MRM facility itself with the `MrmInitialize()` function. This function prepares the application to use the MRM hierarchy fetching utilities by initializing the internal data structures that MRM uses to perform type conversion and access the OSF/Motif Toolkit widget creation facilities.

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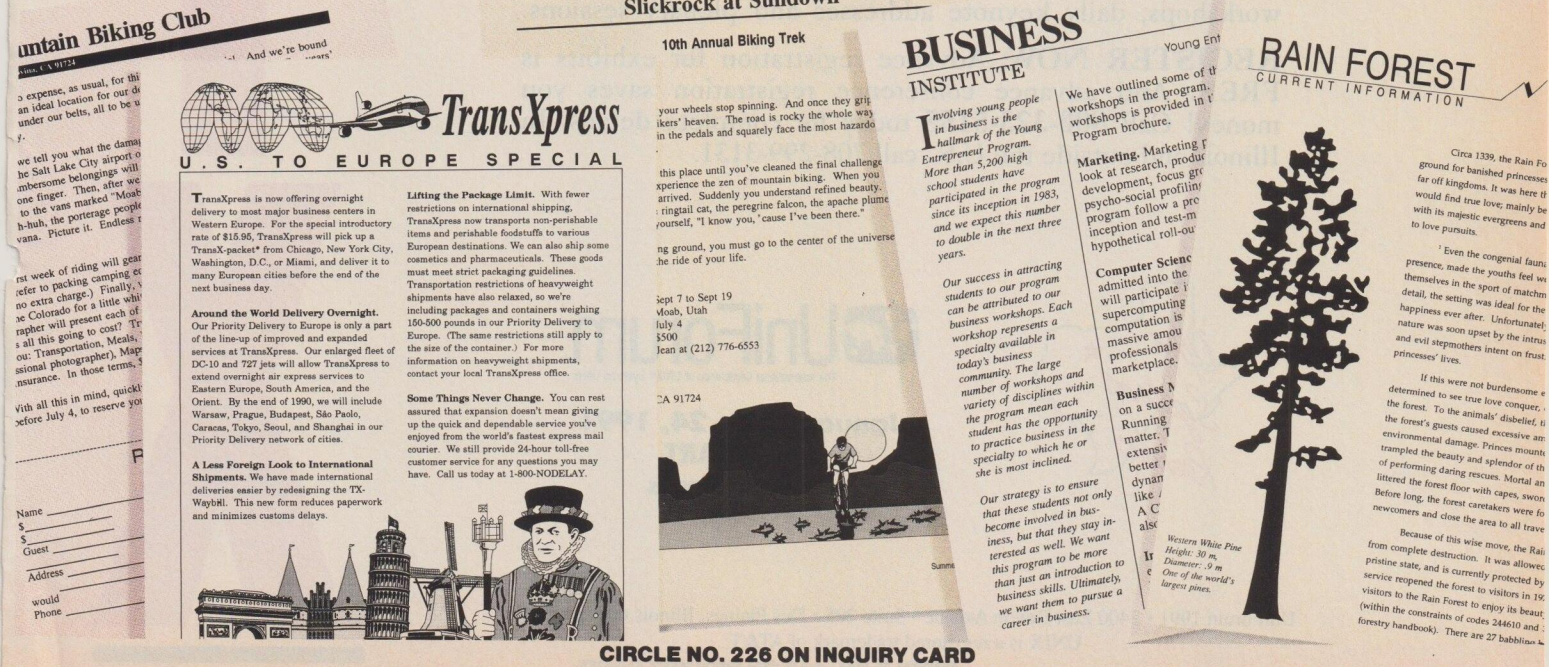

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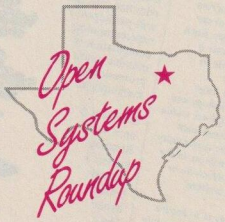

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CIRCLE NO. 112 ON INQUIRY CARD

Listing 3 continued

```
54  /* Reset text area callback function definition: */
55  void ResetCB()
56  {
57      Arg args[1];
58      text_widget = XtNameToWidget(uiltextmain,"text_area");
59      XtSetArg(args[0], XmNvalue, "Text entry area");
60      XtSetValues(text_widget, args, 1);
61  }
62  /* Exit program callback function definition: */
63  void ExitCB()
64  {
65      exit(0);
66  }
```

LISTING 4: Compiling and executing an OSF/Motif application using UIL is a two-step process. First you compile the UIL files used by the C program, then you compile the C program. Changing one of the two files does not require recompiling the other. These listings show the compilation and program invocation command lines for the sample application used in this tutorial.

A. UIL compiler command syntax:

```
uil [ option... ] input-file
```

B. This command line compiles the UID file text entry area example. This file can be read by a C program to build a user interface hierarchy.

```
$ uil -o uiltext.uid uiltext.uil
```

continued

When using UIL and MRM, your C program doesn't need to include the header files for each widget accessed from the UID file. In addition to any header files used by your application's algorithms, you need only include the header files for the X Toolkit (`/usr/include/X11/Intrinsic.h`), the OSF/Motif Toolkit (`/usr/include/Xm/Xm.h`), and MRM (`/usr/include/Mrm/MrmPublic.h`).

The first 28 lines of Listing 3 show the initialization steps for our text entry area example.

Include the User Interface

When using MRM, most user interfaces are built from the UID file in five steps:

- Open the UID file for use with the C program
- Register values from the UID file in the C program
- Fetch and create the widget hierarchy
- Manage and realize the widget hierarchy
- Start the main program loop

continued

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Listing 4 continued

C. This command line compiles the C code for the text entry area example. You must list the library files in the correct order for all OSF/Motif programs.

```
$ cc -o uiltext uiltext.c -lMrm -lXm -lXt -lX11
```

D. This command line executes the text entry area example. You should run most OSF/Motif applications in the background so you don't lose access to the shell running in the X terminal emulator window.

```
$ uiltext &
```

LISTING 5: OSF/Motif Resource Manager functions are used to open a UID file and incorporate its contents into the C program using the OSF/Motif toolkit. MRM functions are used to read values, register callbacks, and build user interface hierarchies from the contents of the UID file. Here's a listing of the usage syntax for these functions:

A. The `MrmInitialize()` *routine prepares an application for using the MRM facilities:*

```
void MrmInitialize()
```

B. The `MrmOpenHierarchy()` *routine opens UID files for use by the MRM facility:*

```
#include <Mrm/MrmPublic.h>
Cardinal MrmOpenHierarchy (num_files, file_names_list,
                           ancillary_structures_list, hierarchy_id)
    MrmCount             num_files;
    String               file_names_list[];
    MrmOsOpenParamPtr    *ancillary_structures_list;
    MrmHierarchy         *hierarchy_id;
```

continued

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The MRM function `MrmOpenHierarchy()` opens the specified UID files and assigns them to an `MrmHierarchy` variable (Listing 5B shows usage syntax). Once opened, the UID file can be read by other MRM functions by referencing the `MrmHierarchy` variable. In our example the UID file is opened on line 31 of Listing 3 and the hierarchy is placed in the variable `s_MrmHierarchy`.

Certain names in the UIL file, such as callback names and new widget names, must be registered in the C program. The syntax for the function that registers callbacks, `MrmRegisterNames()`, is shown in Listing 5C. Our example program needs to register the names of the three Menu PushButton activation callbacks: `ClearCB()`, `ResetCB()`, and `ExitCB()`. This registration step allows you to use different names for the callbacks in the UIL file and the C program, if desired. This name correspondence is registered as the first argument to `MrmRegisterNames()`.

Our program registers its callbacks on line 33 of Listing 3 and the name correspondence is initialized on lines 13 to 17. The first value in each name pair is the name of the procedure in the UIL file and the second value is the name of the function in the C program, which are the same in our example.

The `MrmFetchWidget()` function (see Listing 5D) fetches and creates a widget and its children from the specified UID hierarchy. The first argument specifies the UID hierarchy and the second specifies the name of the widget in the UID hierarchy to fetch, which is also the name of the object in the UIL file. The third argument specifies the parent widget for the widget hierarchy, which is usually the widget ID returned when the X Toolkit is initialized. The widget ID and the class of the top widget created by the hierarchy are returned in the fourth and fifth arguments.

Our example fetches the entire widget hierarchy starting at the MainWindow `uiltextmain` on line 35 of Listing 3. We made the variable that holds the widget ID of the MainWindow a global variable so that we can use this value in the functions later.

Finally, to get the application up on the screen you must manage and realize the widget hierarchy and start the main application loop, just like with any other X application. Lines 39 and 42-43 (Listing 3) show how to do this for our example program. Note that

we only need to manage the newly created `uiltextmain` hierarchy; the application widget does not need to be managed and all the children of the MainWindow are also managed by the `XtManageChild()` function.

Integrate The Application's Algorithms

The three callback routines `ClearCB()`, `ResetCB()`, and `ExitCB()` clear the text area, reset the text area, and exit the application, respectively. Last month, when we built these callback routines using only the OSF/Motif Toolkit, we had access to the widget ID of the text area. Because we built this user interface using UIL and MRM we do not have ready access to the Text widget's ID. We get the widget ID from the name of the text widget using the X Toolkit function `XtNameToWidget()` as shown on lines 50 and 58 of Listing 3. The other routines create an argument list containing a new value for the Text widget using `XtSetArg()`, then they set that value in the Text widget using `XtSetValues()`.

Compile, Test, and Debug the Application

As shown last month, OSF/Motif programs are compiled like any other C program; however, they need to link in the additional libraries `Xm`, `Xt`, and `X11`. An OSF/Motif program using MRM must also specify the library `Mrm` before the library `Xm`. Remember that the order you specify for these libraries is important. Listing 4C shows the compilation command line for our C program, `uiltext.c`.

If `uiltext.c` does not compile properly, you should fix the problem and recompile it. You do not need to recompile the UIL file just because you changed the C file. By the same token, if an error requires a change to the UIL file but not a change to the C program you only need to recompile the UIL file.

You run the compiled program by typing its name after the shell prompt (Listing 4D). Figure 2 shows what the application should look like on the screen both with and without the File Menu posted. This application should behave exactly like the `textentry` example used last month.

Future Directions

I hope these two tutorials have given you a good introduction to the OSF/Motif Tookit and User Interface Language. However, in our limited space we can only scratch the surface of the applications that are possible with OSF/Motif. You can start expanding your knowledge by writing your own OSF/Motif applications or expanding on the text entry area example we used here. It certainly would not be too difficult to add the algorithms for reading and writing the text to a file.

For more information, see the *OSF/Motif Programmer's Guide*, *OSF/Motif Programmer's Reference* and the *OSF/Motif Style Guide*, all written by the OSF technical staff and published by Prentice-Hall.

Listing 5 continued

C. The `MrmRegisterNames()` *routine registers the callback names used in the UIL file:*

```
#include <Mrm/MrmPublic.h>
Cardinal MrmRegisterNames (register_list, register_count)
     MrmRegisterArglist  register_list;
     MrmCount            register_count;
```

D. The `MrmFetchWidget()` *routine fetches a widget hierarchy from the open UID file and creates the widget hierarchy for the application:*

```
#include <Mrm/MrmPublic.h>
Cardinal MrmFetchWidget (hierarchy_id, index, parent_widget,
                         widget, class)
     MrmHierarchy  hierarchy_id;
     String        index;
     Widget        parent_widget;
     Widget       *widget;
     MrmType      *class;
```


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CIRCLE NO. 177 ON INQUIRY CARD

Dr. Rebecca Thomas

ANNUAL INDEX AND CONTEST WINNERS

This year's index brings you up to date on all the great contributions we've had from our readers during 1990. In this index we'll indicate the type of program using a suffix: `.sh` means Bourne shell script, `.c` a C language program, `.awk` an `awk` program, and `.l` a Lex source file. Otherwise, a name without a suffix indicates a standard UNIX utility.

The response to our C/C++ program comment stripping contest, first announced in my June 1990 column, has been overwhelming. As a result, I've decided to award three prizes instead of one.

Bart Besseling wins first place with a C program that uses a versatile table-driven finite-state machine (FSM). Andre van Dalen comes in a close second with his FSM-oriented Lex-generated input filter. And third place goes to Carl Bergerson, who cleverly used the C preprocessor to do most of the work.

My thanks to all who participated. My only regret was that I don't have the space to make awards for more of the many fine entries. But don't fret, you'll have another chance next year.

continued

1990 ANNUAL INDEX

Issue	Program Name	Description
January	**dotree.sh**	Build a graphic directory tree
	lsx.sh	List directory hierarchy
	startprog.c	Synchronize invocation of many processes
	links2.sh	Find all links of a file
	fsplit.sh	Split file into pages at formfeeds
February	**monitor.c**	Monitor port for power failure
	powerfail.sh	Shutdown script in case of power failure
	cleancal.sh	Trim the calendar file
March	**mkshar2.sh**	Improved portable shell archiver
	make	Use `make` to create PERT-like reports
	mkcomment.awk	Make comment around text after `#else` and `#endif` directives
	uuqstat.sh	Simplified HoneyDanBer job queue status
	findlinks.sh	Locate path names for all links
	csed2.sh	Improved context sed search command that handles multiple files
April	**smartroff.sh**	Run embedded command on document
	cb	Using `cb` to check C syntax
	dfspace.sh	Percentage of remaining disk space
May	**autologout.c**	Log off idle users
	today3.c	Print calendar highlighting today
	calprog.c	C version of the UNIX `calprog` script
June	**pdir.sh**	Simple phone directory searcher
	scpp.sh	Small cpp that supports conditional compilation
	mksidlist.sh	Create SUID/SGID file database
	chksids.sh	Check for unauthorized SUID/SGID files
July	**sccs.sh**	Front end for basic SCCS operations
	sprs.sh	Simplified SCCS `prs` command report
	chksulog.sh	Check log for unauthorized `su` usage
August	**kolgrep.sh**	Pattern search using specified field
	copy.sh	Copy file to one or more destinations
	login.c	Description of secure `login` program (source available from UUNET archives)
September	**ved.sh**,	VMS-style editor front end
	versions.sh,	Reports on file versions created with `ved`
	purge.sh	Remove excess versions of files
	mkfilelist.sh,	Create system files database
	chkfiles.sh	Check modes and owners of files in database
October	**sumtbl.sh**	Script-wrapped `nawk` program to sum field contents in `tbl`-source file
	nsum.c	Secure checksum program
	dfspace2.sh	Report free disk space on SCO XENIX
November	**tprint.sh**	Format and print document automatically
	mmake.sh	Simple makefile generator
	dpasswd.c	Install a dial-up password file entry
December	**cstrip.c**	Strip C/C++ comments using FSM-C program
	sc.l	Strip C/C++ comments using FSM-Lex program
	cs.sh	Strip C/C++ comments using C preprocessor

I'll have another coding contest, because this year's competition drew so much interest.

Gold Medal Winner

Dear Dr. Thomas:

My program to strip comments from C and C++ programs is an example of a classic family of applications for the UNIX system—the filter program. Part of the early appeal of this operating system was that one could string together these simple filter programs and create complex data processing applications.

Each filter has a standard input and a standard output stream of bytes. A filter may also need to remember part of the previously processed input to be able to process the next input correctly—at every moment the filter is in a certain "state." The input modifies the state and causes the filter to perform output operations. Because the number of different states is finite, such filters are often called finite-state machines.

To be correct, the filter must respond appropriately to all possible input in every state. In traditional programs, correctness is difficult to verify, because part of the state is hidden in the program counter. If the filter is in one state, the program is executing one loop; in another state, the program is executing another loop. Not only is it difficult to ascertain the correct operation of such a program, it is also difficult to add functionality to it without introducing bugs. At best, an addition ruins the original structure.

State can be made explicit using a variable—the program constantly cycles through the same small loop while a variable assumes different values. Each possible next state is a constant function of the current state and the current input value. This function can be stored in a pre-initialized array and be interpreted by the main program loop. The new state is computed using $s = m[s][c]$, where s is the state, `m[][]` is the array and, c is the input value. If we used the current input byte as an index, the array would become very large and most elements would contain the same value. Therefore, for efficiency we should classify input bytes into categories and use the category as the index. A well-chosen set of states and input categories makes a finite-state machine easy to understand and modify. The use of an array makes every possible state transition immediately obvious.

LISTING 1: Our first place winner chose to submit a table-driven finite state machine C program listed here.

```
#include <stdio.h>
char *sccsID="@(#) cstrip.c 1.1 Bart J. Besseling, 8/90";

int m[9][8] = { /* finite-state machine */
/* events:
        /    *    "    '    \   \n   sp    ch      states: */
    { 0x01,0x80,0x85,0x87,0x80,0x80,0x80,0x80 },  /* 0: hunt */
    { 0x02,0x33,0xc0,0xc0,0xc0,0xc0,0xc0,0xc0 },  /* 1: maybe */
    { 0x02,0x02,0x02,0x02,0x02,0x80,0x02,0x02 },  /* 2: c++ */
    { 0x13,0x14,0x13,0x13,0x13,0x83,0x83,0x13 },  /* 3: c */
    { 0x10,0x13,0x13,0x13,0x13,0x83,0x83,0x13 },  /* 4: end c */
    { 0x85,0x85,0x80,0x85,0x86,0x80,0x85,0x85 },  /* 5: string */
    { 0x85,0x85,0x85,0x85,0x85,0x85,0x85,0x85 },  /* 6: \ in str */
    { 0x87,0x87,0x87,0x80,0x88,0x80,0x87,0x87 },  /* 7: char */
    { 0x87,0x87,0x87,0x87,0x87,0x87,0x87,0x87 },  /* 8: \ in char */
};

int
main() /* Input parser and output generator */
{
    register int    ch, event, state;

    for (state = 0; (ch = getchar()) != EOF;) {
        /* translate character into event */
        switch (ch) {
            case '/':   event = 0; break;
            case '*':   event = 1; break;
            case '"':   event = 2; break;
            case '\'':  event = 3; break;
            case '\\':  event = 4; break;
            case '\n':  event = 5; break;
            case '\t':
            case ' ':   event = 6; break;
            default:    event = 7; break;
        }
        /* obtain next state and operation from machine */
        state = m[state & 0x0f][event];
        /* perform operation */
        if (state & 0x10) putchar(' ');
        if (state & 0x20) putchar(' ');
        if (state & 0x40) putchar('/');
        if (state & 0x80) putchar(ch);
    }
    return 0;
}
```

Clearly, for a comment-stripping program there are two main states: (1) we are reading program code or (2) we are reading a comment. Because C++ adds a (in my opinion, totally unnecessary) new style of comment, the "in comment" state must be split into two separate states: (2A) we are reading a C comment and (2B) we are reading a C++ comment. We also need some intermediary states because both comment styles are announced by a sequence of characters. If we only see the first character of a sequence but not the second, we are still reading program code. Similarly, additional states are needed at the end of comments. A comment in a string is not really a comment, as in `printf("/*not a comment*/\n")`.

A state transition could cause the filter to perform output operations. The operations can be numbered, and the numbers can be stored in an array similar to that used for the state transitions. An operation would be selected by $op = m2[s][c]$ where op is the number of the operation. In my contributed program, named `cstrip`, I have made the operation numbers bit masks in the state-transition array. This approach reduces the number of indexing calculations, and it also allows me to perform more than one operation per transition.

The program can easily be expanded to remove redundant white space at the end of a line, or strip shell comments and preprocessor lines.

[*Doctor's note:* Listing 1 shows the source code for the `cstrip` program.]

[*Author's overview:* This filter removes comments from C and C++ programs while leaving the overall

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LISTING 2: Our second place winner used a Lex-generated input filter set up as a finite state machine.

A. Listing of the Lex program:

```
%Start CODE CCOM STRING CHAR CPLUS
%%
%{
    char *sccsID = "@(#) sc 1.0 Andre van Dalen, 6/90";
    BEGIN CODE;
%}
<STRING>([^\\]\")|(\\\\\")   |
<CHAR>([^\\]\')|(\\\\\')     |
<CPLUS>\n          { ECHO; BEGIN CODE ;}
<CCOM>"*/"         { two_space(); BEGIN CODE ;}
<CCOM,CPLUS>.      { output(*yytext=='\t'?'\t':' '); }
<CODE>"/*"         { two_space(); BEGIN CCOM ; }
<CODE>"//"         { two_space(); BEGIN CPLUS ;}
<CODE>\"           { ECHO; BEGIN STRING ; }
<CODE>\'           { ECHO; BEGIN CHAR; }
<STRING,CODE>.     { ECHO; }
%%
two_space()
{
    output(' '); output(' ');
}
main(argc, argv)
int argc; char **argv;
{
    if (argc == 1)  /* if no arguments */
        yylex();    /* act as a filter */
    else
        while (*++argv) { /* for all input files */
            fclose(yyin);   /* release old descriptor */
            if (!(yyin = fopen(*argv, "r"))) {  /* if can't open */
                perror(*argv);  /* display what went wrong */
                exit(1);        /* and quit */
            }
            yylex();    /* strip the comments */
        }
    exit(0);    /* normal termination */
}
```

continued

layout of the program text intact. Various input characters are classified as events for a finite-state machine, which makes one state transition for every character. The low-order bits of the state machine value indicate the next state, and the high-order bits indicate the processing to be done. Possible enhancements include stripping white space at the end of a line and an argument parser.]

Bart J. Besseling
MIS Department
Nissan Motor Acceptance Corporation
Torrance, Calif.

Silver Medal Winner

Dear Dr. Thomas:

Enclosed you'll find my entry for the C/C++ comment stripping contest. I chose to use Lex, because this utility is available on almost all UNIX systems, so my contribution should be highly portable.

I did not follow the rules to the letter, "output should be like the input except all comment text has been replaced by same number of spaces," because I leave tabs and newlines intact to preserve the layout of the program code. I also took the liberty of only stripping legal C code, so constructions like `\/*` aren't handled and will be recognized as starting a comment and the backslash left behind, which will cause a compilation error.

The program itself defines a finite-state machine with the state's code, string constant, character constant, C comment and C++ comment, reproducing the input except for the comments, which are replaced by spaces. The `main()` routine makes my program behave like a "comment-stripping `cat`," acting as a filter if invoked without arguments.

I ran this program on a Nixdorf Targon 35 in both the AT&T (Sys V.2) and UCB (BSD 4.2) universes and on a Nixdorf Targon 31 under AT&T System V.3.

[*Doctor's notes:* Part A of Listing 2 shows the Lex input file, and Part B a make file to create the executable.]

[*Doctor's explanation:* Here's some background for our readers unfamiliar

Listing 2 continued

B. A make file for creating the executable image (line numbers shown don't appear in the actual file):

```
1 #  @(#) Makefile for cs (comment stripper)
2 #  Author: Andre van Dalen,  June 1990
3 #
4 OBJS = cs.o
5 all: cs.c cs
6 cs.c: cs.l
7 cs: $(OBJS)
8         $(CC) -o $@ $(OBJS) -ll  line begins with <tab>
```

C. General format for a Lex specification file:

```
definitions
%%
rules    [ = pattern  action ...]
%%
user-defined routines
```

with Lex: Listing 2C names the three sections of a Lex specification file. Only the *rules* section is required, and the sections are separated from one another by the `%%` character sequence. Our example (Listing 2A) uses all three sections.

The *definitions* section defines the start conditions (or states). The *rules* section begins with a special `%{` and `%}` code block that contains a declaration for the `sccsID` character array, generally used to identify the compiled program with the SCCS `what` command and the begin start condition. The contents of this code block will be placed at the beginning of the `yylex()` routine.

The rest of the *rules* section consists of *pattern action* pairs, one per line. If Lex recognizes an input string matching the regular expression *pattern*, then the corresponding *action* is performed. All our patterns are qualified by a start condition, which specifies the *rules* valid in a particular state (used to implement the FSM).

The *user routines* in our example define the `main()` and `two_space()` functions. Note that the lexical analyzer routine, `yylex()`, is constructed automatically by Lex from the *rules* section.

We create our executable program, `cs`, using a make-description file (see Listing 2B). Line 6 tells make that the resulting C program depends on the Lex specification file, `cs.l`. When you run `make`, it will in turn run the `lex` command on `cs.l`, and then rename the resulting `lex.yy.c` file to `cs.c`. Then `make` uses a default suffix rule to compile `cs.c` with `cc -c` to create the `cs.o` file. Lines 7-8 tell `make` how to link `cs.o` to create our program. Note that the Lex library must be specified (use `-ll`), so required definitions and other necessary routines are added to the `cs` executable.

For more information on Lex, see your UNIX *Programmer's Guide* manual and the new Nutshell handbook written by Tony Mason and Doug Brown, edited by Dale Dougherty, *lex & yacc,* published 1990 by O'Reilly & Associates, Inc., Sebastopol, Calif.]

Andre van Dalen
Woerden,
The Netherlands

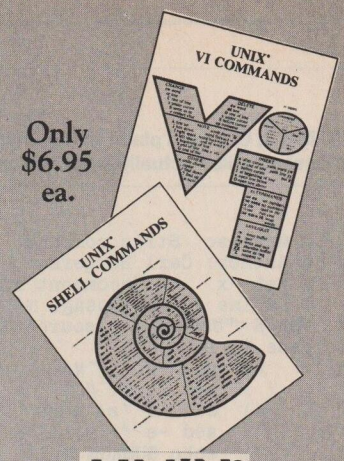
Bronze Medal Winner

Dear Dr. Thomas:

My entry for your "strip" contest (named `sc`) is a short script [See Listing 3] that uses the C preprocessor to strip the comments from C or C++ files. My script is written as a filter because `cpp` can take input from its standard input file. The objective of the two passes through `sed` are to hide and then reveal all preprocessor directives. Thus, the C preprocessor does nothing significant except strip comments.

This script was developed under MS-DOS 3.30 using the MKS toolkit version 2.2c and the Microsoft C compiler version 5.1. It was also tested under RISC/OS 4.50 and XENIX 386 version 2.3.2. In the DOS environment, the script behaves properly. In the two UNIX environments, however, the preprocessor fails to remove C++ program comments. This shortcoming is not a failure of the script, but rather a limitation of the C preprocessor.

[*Doctor's explanation:* Line 6 defines a correct usage message. The case



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LISTING 3: Our third place winner placed a shell script wrapper around the C preprocessor, which actually strips the comments.

```
1   :
2   # @(#) sc  Strip comments from a C/C++ source file
3   # Author: Carl Bergerson, August 1990
4   # set -x    # Uncomment for debugging
5   # Define correct usage message:
6   USAGE="Usage: $0 [sourcefile]"
7   case $# in
8       0)  sed -e 's/^#/a#/' | /lib/cpp |
9           sed -e '/^#/d' -e 's/^a#/#/';;
10      1)  sed -e 's/^#/a#/' $1 | /lib/cpp |
11          sed -e '/^#/d' -e 's/^a#/#/';;
12      *)  echo $USAGE >&2
13          exit 1 ;;
14  esac
```

statement encompassing lines 7-14 handle the command line arguments: Lines 8-9 handle the case when no file argument is specified ($# is 0), so the standard input is filtered. Lines 10-11 treat the case where a single file argument is named on the command line ($# is 1) . And if more than one argument is listed, line 12 prints the correct usage message and line 13 terminates the script.

Although the C preprocessor will remove comments, it also processes all its directives, which begin with a pound sign (#) in the first column of the source file. The result would be an unusable source file. So the author "hides" the preprocessor directives by substituting another character (a lowercase "a") ahead of the pound sign in lines 8 and 10. After the C preprocessor pass, the `sed` command on lines 9 and 11 removes extraneous data introduced by `cpp` (lines that begin with a pound sign) and "unhides" the preprocessor directives so the source file is ready for subsequent use.]

Carl Bergerson
Laguna Niguel, Calif.

Wanted: Stump the Winners

Although the winning programs presented here correctly strip all the C/C++ programs I've tried, you might be able to come up with legal C/C++ code that one or more of these programs doesn't handle. If so, please submit them for consideration. I'd like to give the winners a chance to fine-tune their entries so their programs do the job in a production environment. □

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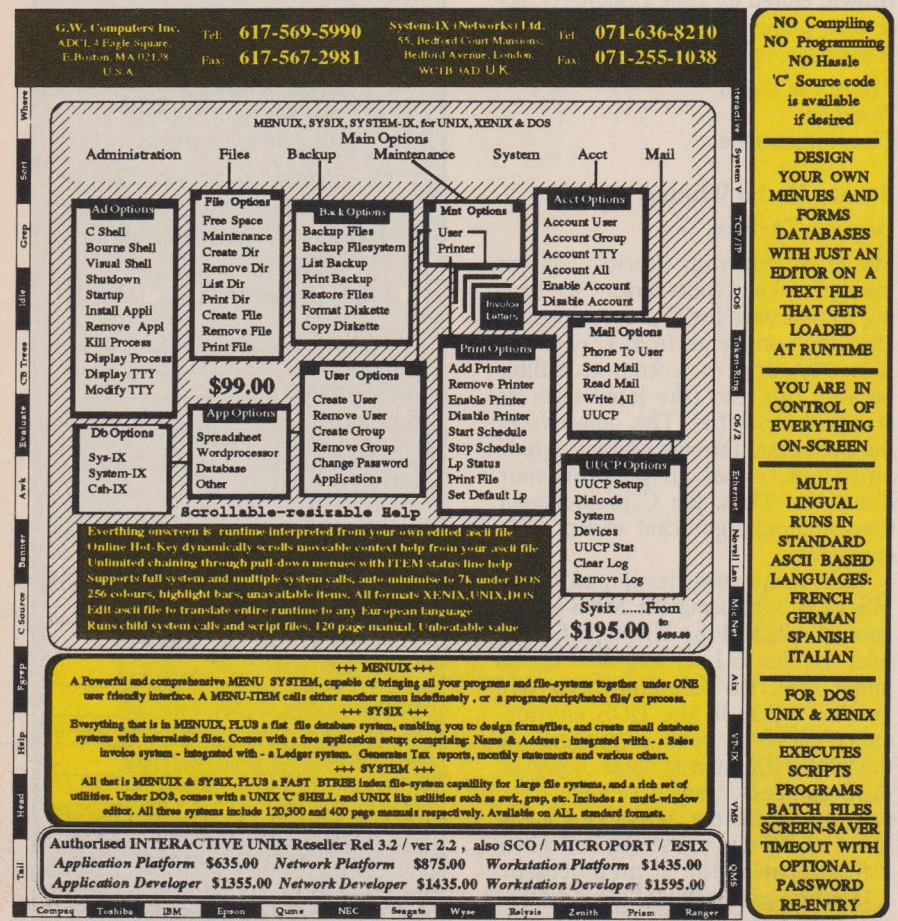
Briefly describe the hardware and software environment (especially the UNIX system version) on which the contributed code was run.

If possible, you should write code that is portable across the popular versions of the UNIX system (System V.X, 4.XBSD, XENIX). Write Bourne or Korn (but not C) shell scripts and use universally available utilities, for example, `who am i` (all systems) instead of `whoami` (Berkeley only). If feasible, use `getopts(1)` or `getopt(3C)` to process command-line options and their arguments.

Use the standard I/O library for structured modular C code. Check source code for nonportable constructions with `lint`. Eliminate hardware dependencies, such as terminal control sequences. (Use `termcap` or `terminfo`.) Isolate nonportable code to one region or a separate module. Keep examples compact (under 100 lines of code with each line less than 65 characters long—counting tabs as 4 spaces) and explanations concise (under 400 words). Use `sed` instead of `ed` scripts, pipelines instead of intermediate temporary files, etc. Be succinct!



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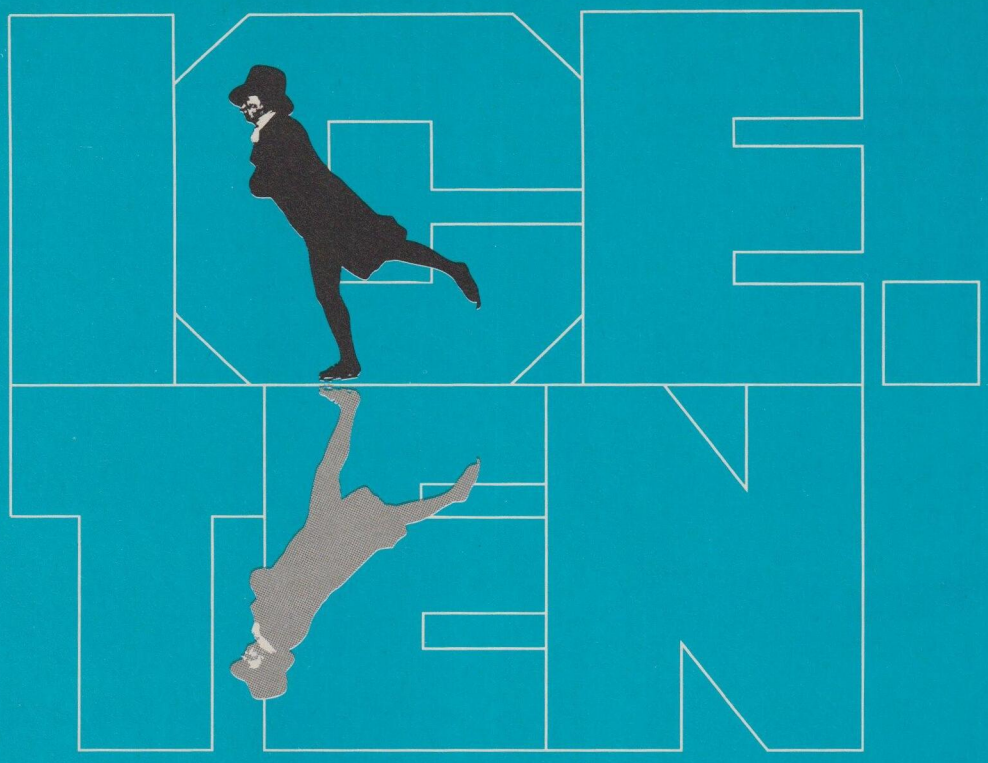

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QUEUES, DATABASE CONVERSIONS, AND POSIX

This month's first question asks how to write a job queuing system. The second is a request to modify a shell script so that it can recognize command-line options. The third question asks, "What's Posix?"

Minding Your P's and Queues

Question: We are currently using `batch` to queue jobs. I need to add some features to the system, but because I don't have source, I was wondering how to write a basic, yet flexible, job queuing system that I could enhance. I want only one job to run at a time, but have 60 users who need to be able to submit jobs at any time. The queuing system should execute commands in the order they were queued and keep a log of jobs processed.

Emory Horten
Willamette, Ore.

Answer: There are several ways to write a job queuing system. The basic design calls for two programs: the sender, which allows users to schedule jobs, and the server, which reads the job description from the queue and executes it. These programs can be either shell scripts or C programs. The job queue can be stored in a file, or passed to the server through a named pipe or by some other system-supplied interprocess communication (IPC) method. The system described here is written in C and uses System V-supported message queues for IPC.

I chose message queue IPC for several reasons: First, messages can be stored and retrieved individually, which reduces the programming effort compared to using a file, named pipe, or other IPC method. Second, messages are stored in first-in, first-out (FIFO) order, so commands are executed in the order they were queued. Third, it's convenient that the message data structure consists of two parts, a long integer and a character string. I store the identification number of the user in the long integer field and the command to be executed in the string. The user-id number will be used to reset the effective user-id of the process running the submitted command.

A message queue is accessed much like a file; however, instead of a name, message queues are identified by numeric keys. In this example, I've used the hexadecimal key `0x200`. Message queues are made available to the program through a kind of "open" call, `msgget()`. Once opened, the queue is identified by a number, `msqid`, which is used like a file descriptor. Messages are placed in the queue with `msgsnd()` and retrieved by `msgrcv()`. A queue can be manipulated, say, to change permission modes or ownership, using `msgctl()` . For more information on how these system calls work, see section 2 of your UNIX System V *Programmer's Reference Manual.*

My job queuing system consists of two programs, `qsend` and `qex`, which access the same message queue. The `qsend` program (Listing 1A) places a message containing the command line onto the queue, while the `qex` program (Listing 1B) removes a message and executes the command line specified in it. Here's a brief explanation of `qsend` program operation:

First, `qsend` collects the user-id of the invoker (line 20 of Listing 1A) and makes sure that it's not the superuser (user-id is 0). (The server, `qex`, executes commands as the user who queued the job.) For security reasons, I decided not to let the superuser queue jobs. Then, `msgget()` is used to retrieve the identifier for the message queue associated with the `MSGKEY` key (lines 25-27).

Next, the user is prompted for the command to put in the queue (line 28), and that line is read with `fgets()` into buffer `instr` (line 29). Lines 31-32 replace the newline left by `fgets()` with a null (string terminator). Lines 33-34 make sure that the command line will fit into the message structure, or the program aborts. Line 36 copies the command line into the message structure, and line 37 inserts the user-id value. Line 39 calls `msgsnd()`

LISTING 1: A job queuing system requires two programs. One sends commands into the queue (`qsend`) and the other executes the queued jobs (`qex`).

A. Listing of the `qsend` *program source code:*

```
 1  #include <stdio.h>
 2  #include <sys/types.h>
 3  #include <sys/ipc.h>
 4  #include <sys/msg.h>
 5  #include <errno.h>
 6  #define MSGKEY (key_t) 0x200     /* key for message queue */
 7  #define MSGSIZE 100              /* max. length of command */
 8  void exit(), perror();           /* make lint happy */
 9
10  main()
11  {
12      int     msqid;              /* message queue descriptor */
13      int     msglen;             /* length of message text */
14      uid_t   uid;                /* user-id number */
15      char    instr[BUFSIZ];      /* buffer for command line */
16      struct  msgtype {
17          long msgnum;            /* storage for user-id number */
18          char msgtext[MSGSIZE + 1];  /* storage for command */
19      } msg;
```

continued

to place the message on the queue. Incidentally, the command line to execute is not specified on the command line used to invoke `qsend` to prevent the shell from possibly changing the execution command line before it is passed to `qsend`.

The `qex` job queue server program is more complicated because it must retrieve the command line from the queue, format it properly, create a process to execute the command, and then send the user mail identifying where the output of the command can be found. Because the submitted commands are executed by the `qex` daemon—which isn't designed to be attached to a user's log-in terminal—the output can't simply be sent to the standard output. Instead, `qex` redirects the standard error and output to a file in the `/usr/spool/qex` spooling directory, and also makes a log entry in `/usr/spool/qex/jobqueue.log`, identifying what command was executed by which user.

The `qex` program (Listing 1B) calls `msgget()` (line 27) to retrieve the message queue identifier for the specified key, `MSGKEY`. If the queue doesn't exist, it will be created because the `IPC_CREAT` flag was specified. The `MSGPERMS` constant defines the permission modes for the newly created message queue. As with a file, a queue's permissions identify whether the owner, group, and others can read and write the queue (the execution bit of a queue's permissions has no meaning). Line 30 attempts to open the log file or creates a new one if the log doesn't already exist.

The program spends the rest of the time executing in the while loop encompassing lines 33-60. This loop attempts to read the next command-line message from the queue (line 33) and then forks a new process (line 34) to run the command. A new process is necessary because the `qex` process will be run as root and the command should be run in a process owned by the user who submitted the job. Line 39 sets the real and effective user-id of the child process to be those stored in the message-number field of the message structure. If the user-id change is successful, the log-in name associated with that user-id is retrieved (line 44).

The command to be executed will have its standard error and standard output redirected to a file (in the `/usr/spool/qex` directory) whose name is the process-id for the forked child process (set up by lines 48-49). The command is executed by the `system()` library routine called from line 50. Lines 51-54 send the user mail, telling where the command output, if any, can be found and then the child exits. Meanwhile, the parent process waits for the child to finish (line 58).

When a SIGTERM signal is caught by `qex`, `quit()` is called. In `quit()`, the log file is closed, a termination message displayed, and `qex` exits. Note that the message queue is not deleted, which would have removed the unexecuted commands in the queue. A queue's contents get deleted when the system is shut down.

The `qex` program should be run when the system is brought to multiuser operation (generally run level 2). This can be done automatically by invoking `qex` in one of the script files located in `/etc/rc2.d` (System V.3 and later) or by an entry in the `/etc/rc` file (System V.2 and earlier versions). Listing 1C shows some sam-

Listing 1 continued

```
20      if ((uid = getuid()) == 0) {    /* superuser user-id = 0 */
21          fprintf(stderr, "Superuser can't queue commands.\n");
22          exit(1);
23      }
24      /* Retrieve identifier for queue associated with key */
25      if ((msqid = msgget(MSGKEY, 0)) < 0) {
26          perror("Can't access message queue"); exit(2);
27      }
28      (void)printf("Enter command to submit to job queue: ");
29      (void)fgets(instr, BUFSIZ, stdin);  /* collect command line */
30      msglen = strlen(instr);
31      if (instr[msglen - 1] == '\n')
32          instr[msglen - 1] = '\0';   /* nullify newline */
33      if (msglen - 1 > MSGSIZE) { /* command larger than container */
34          (void)fprintf(stderr, "Command line too long.\n"); exit(3);
35      } else {
36          (void)strcpy(msg.msgtext, instr);   /* store command line */
37          msg.msgnum = uid;   /* store user-id */
38      }
39      if (msgsnd(msqid, &msg, sizeof(msg.msgtext), 0)) {
40          perror("Can't queue command"); exit(4);
41      }
42      exit(0);
43  }
```

B. The `qex` *job queue server program:*

```
 1  #include <stdio.h>
 2  #include <sys/types.h>
 3  #include <sys/ipc.h>
 4  #include <sys/msg.h>
 5  #include <signal.h>
 6  #include <errno.h>
 7  #include <pwd.h>
 8  #define MSGKEY (key_t) 0x200 /* key for message queue */
 9  #define MSGPERMS 0666 /* permission set for queue */
10  #define MSGSIZE 100 /* max. length of command line */
11  #define CMDLINE "%s 2>&1 >/usr/spool/qex/%d"
12  static FILE *lfp;   /* logging file FILE pointer */
13  void exit(), perror(); int quit();  /* keep lint happy */
14
15  main()
16  {
17      static int msqid;       /* message queue identifier */
18      char    instr[BUFSIZ];  /* buffer area for command line */
19      FILE    *fopen();       /* declare before call */
20      struct  msgtype {       /* message data structure */
21          long msgnum;
22          char msgtext[MSGSIZE + 1];
23      } msg;
24      struct passwd *user, *getpwuid();   /* password file access */
25
26      (void)signal(SIGTERM, quit); /* catch termination signal */
27      if ((msqid = msgget(MSGKEY, MSGPERMS | IPC_CREAT)) < 0) {
28          perror("Can't get queue identifier"); exit(1);
29      }
30      if ((lfp = fopen("/usr/spool/qex/jobqueue.log", "a")) == NULL) {
31        (void)fprintf(stderr, "Can't open logging file.\n"); exit(2);
32      }
```

continued

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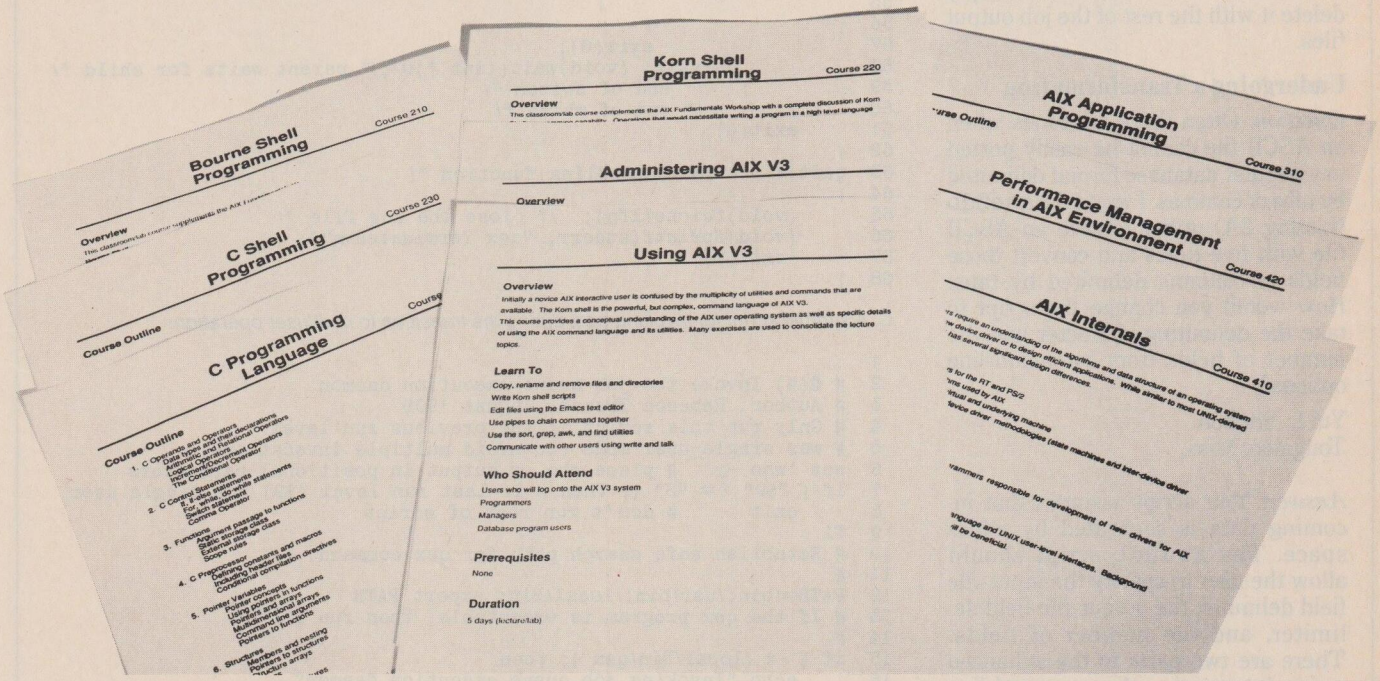

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ple shell script code for invoking `qex`.

Because `qsend` is to be run by anyone needing to queue a job, it has to be executable by others. I suggest that it be owned by `root`, stored in local `bin` directories that all users have in their path (such as `/usr/lbin` or `/local/bin`), and that it have 111 permissions (`--x--x--x`). The `qex` daemon is run by `init` at startup and should be owned by `root` with 100 permission modes (`--x------`).

The queuing system does require some maintenance. Periodically, erase the files in the `/usr/spool/qex` directory. Before you clear that directory, you need to review the `jobqueue.log` file and either move it elsewhere, remove all but some entries near the end of the file, or simply delete it with the rest of the job output files.

Undergoing a Transformation

Question: Often there are times when an ASCII file cannot be easily ported to a popular database format delimited by tabs or commas. I wrote the `asc2db` (Listing 2A) utility to take an ASCII file with five fields and convert those fields to columns delimited by tabs. How would you change the script to take the delimiting character and the number of fields from command-line options?

Yul L. Shelton
Tougaloo, Miss.

Answer: Your script assumes that incoming data is separated by white space. The `asc2db` script should allow the user to specify the input-file field delimiter, the output-file field delimiter, and the number of fields. There are two parts to the enhanced script: interpreting the command line used to invoke the script and rewriting the `awk` program to handle the values identified from the command-line arguments.

The `getopts` command, which is built into the Bourne and Korn shells, can process command-line options and their arguments conveniently. Also, `getopts` ensures that the script will comply with the UNIX command syntax standard (see Intro(1) section in the *User's Reference Manual*).

This command is passed two arguments: a string of valid command-line options and a variable name (see Listing 2B). When executed in a loop, `getopts` examines each command-line argument in turn to see if it's a valid option (starts with a minus sign and is followed by one of the letters in *options-string*). If so, `getopts` stores the matched option letter in *variable* and returns a zero exit status. If the letter following a minus sign isn't matched, `getopts` stores a question mark (`?`) inside *variable*, writes a warning message to the standard error, but still returns a zero exit status. If all command-line arguments have been examined or the next argument doesn't begin with a minus sign, `getopts` returns a non-zero exit status, which should be used to terminate the loop controlling its execution.

To construct *options-string* catenate all valid option letters, placing a colon (`:`) after any letter if the corresponding option also takes an argument. For example, the command `getopts i:o:f: arg` looks for an i, o, or f option on the command line, each followed by an argument, which must be separated from the option letter by white space. If found, the option letter is stored in `arg` and the option argument is placed in a variable named `OPTARG`. Lines 11-20 in Listing 2C demonstrate how to use `getopts` in a loop.

continued

Listing 1 continued

```
33      while (msgrcv(msqid, &msg, MSGSIZE + 1, 0L, 0) >= 0) {
34          switch (fork()) {
35            case -1:  /* fork failed */
36              (void)fprintf(lfp, "Couldn't fork: %s\n", msg.msgtext);
37              break;
38            case  0:  /* child process code: */
39                  if (setuid((int) msg.msgnum)<0){/* can't reset UID */
40                      (void)fprintf(lfp,
41                          "Couldn't reset UID %ld for job: %s\n",
42                          msg.msgnum, msg.msgtext);
43                  } else {    /* can reset UID */
44                      if ((user=getpwuid((uid_t)msg.msgnum)) !=NULL) {
45                          (void)fprintf(lfp,
46                                  "Executed job: %s for UID %ld\n",
47                                  msg.msgtext, msg.msgnum);
48                          (void)sprintf(instr, CMDLINE,
49                                  msg.msgtext, getpid());
50                          (void)system(instr);    /* run command */
51                          (void)sprintf(instr, "echo \"output from \
52  command %s in file /usr/spool/qex/%d\" | /bin/mail %s",
53                              msg.msgtext, getpid(), user->pw_name);
54                          (void)system(instr);    /* send mail */
55                      }
56                  }
57                  exit(0);
58            default: (void)wait((int *)0);/* parent waits for child */
59          }   /* end of switch */
60      }       /* end of while */
61      exit(0);
62  }
63  quit()  /* abort handling function */
64  {
65      (void)fclose(lfp);  /* close the log file */
66      (void)fprintf(stderr, "qex Terminated\n");
67       exit(0);
68  }
```

C. A sample script for invoking `qex` *during the transition to multiuser operation:*

```
 1  :
 2  # @(#) Invoke the job queue execution daemon
 3  # Author: Rebecca Thomas, August 1990
 4  # Only run this script if the previous run level
 5  # was single-user mode (to avoid multiple invocations):
 6  set `who -r`  # place who -r output in positional parameters
 7  if [ "$9" != "S" ]; then # if last run level ($9) not single user
 8      exit      # don't run rest of script
 9  fi
10  # Establish safe search path for qex command:
11  #
12  PATH=/bin:/usr/bin:/local/Bin; export PATH
13  # If the qex program is executable, then run it:
14  #
15  if [ -x /local/Bin/qex ]; then
16      echo "Invoking job queue execution daemon"
17      /local/Bin/qex &
18  fi
```

Each time `getopts` returns, the variable `OPTIND` is incremented. Initially it is set to 1 (one), and after being updated, its value corresponds to the number of the next command-line argument to be processed. When all the command-line options have been examined, you need to shift them out of the way so the non-option arguments are accessible. Because `OPTIND` references the next argument after the last option, subtract one and shift by the remainder. Line 21 shows how this is done.

After the shift over the options, the number of (remaining) command-line arguments (in `$#`) should be one, where the argument is the name of the data file. The case statement encompassing lines 22-30 checks the number of remaining arguments and takes appropriate action—if zero or more than one argument remains, the appropriate message is displayed and the script terminates.

Line 31 makes a copy of the original data in case an error occurs during pro-

LISTING 2: Many database programs can read data that is formatted as an ASCII file in a specific format. The asc2db script allows a user to create files in the proper format.

A. The original `asc2db` *script:*

```
1  sed -n '/^[^ ]/p' $1 |
2  awk {'printf "%-8s\t%s\t%s\t%-8s\t%s\n", $1, $2, $3, $4 ,$5'} > tmpp
3  mv tmpp $1
4  echo "DONE."
```

B. General `getopts` *invocation syntax:*

```
getopts options-string variable
```

C. Listing of the new `asc2db` *script, which handles command-line arguments:*

```
 1  :
 2  # @(#) asc2db  Convert ASCII file to database format
 3  # Author: Yul Shelton; Modified by Ray Swartz, Becca Thomas
 4  trap 'rm /tmp/asc2db$$ 2>/dev/null; exit' 1 2 3 15
 5  USAGE="Usage: $0 [ -i char ] [ -o char ] [ -f number ] filename"
 6  # Define default values:
 7  indel=' '   # default input delimiter is a space
 8  outdel='    '   # default output delimiter is a tab
 9  fields=1    # One field by default
10  # Process the command line:
11  while getopts i:o:f: arg
12  do
13      case $arg in
14          i)  indel="$OPTARG" ;;  # reset input delimiter
15          o)  outdel="$OPTARG" ;; # reset output delimiter
16          f)  fields="$OPTARG" ;; # reset field count
```

continued

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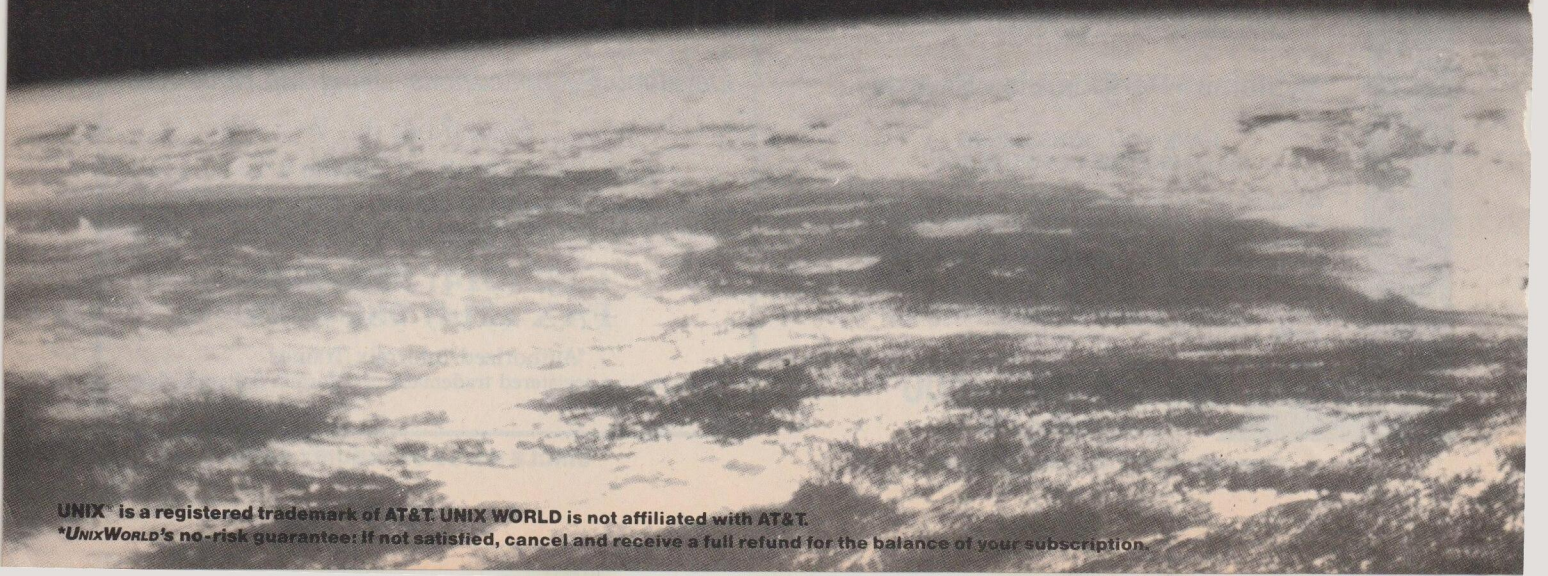

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cessing that would corrupt the original data file. The actual processing occurs in lines 32-37. First, the `sed` command on line 32 only outputs lines from the input file that don't start with a space character. These lines are then piped into the `awk` program.

The `BEGIN` section (line 33) sets `awk`'s input-field separator (`FS`) to the value stored in the `indel` shell variable. Incidentally, there are three sets of quotes around `$indel`. The outermost set of double quotes tells `awk` that a string is enclosed. The second set of single quotes consists of the closing single quote of a pair that begins the `awk` program (before the "B" in `BEGIN`) and the opening single quote of a pair that continues the `awk` program. This quoting allows the `awk` program to access the value of the `indel` shell variable. The third and innermost set of the double quotes tell the shell to only perform parameter substitution on the `indel` variable. Note that similar quoting allows the `awk` program to access the `fields` and `outdel` shell variables as well.

Listing 2 continued

```
17          \?) echo $USAGE >& 2     # unrecognized option
18              exit 1 ;;
19      esac
20  done
21  shift 'expr $OPTIND - 1'         # shift over options
22  case $# in  # check number of remaining arguments
23      0)  echo "Missing file name" >&2
24          echo $USAGE >&2
25          exit 2 ;;
26      1)  ;;  # should only be one argument left
27      *)  echo "Too many file names" >&2
28          echo $USAGE >&2
29          exit 3 ;;
30  esac
31  cp $1 $1.old                     # make backup copy of input file
32  sed -n '/^[^ ]/p' $1 |   # get lines that don't begin with space
33  awk 'BEGIN {FS = "'"$indel"'"}  # set input field separator
34      {for (i = 1; i < '"$fields"'; i++)  # for input line fields
35          printf "%s%s", $i, "'"$outdel"'" # output field/delimiter
36      printf "%s\n", $i }' > /tmp/asc2db$$  # last field/no delimiter
37  mv /tmp/asc2db$$ $1              # overwrite input file
38  echo "DONE."                     # tell user we're finished
```

In lines 34 and 35, `awk` prints the contents of each input-line field, except the last one, followed by the output delimiter (stored in `outdel`). Line 36 prints the last input-line field, followed by a newline. The output of `awk` is redirected to a temporary file that is given a unique name, which is the script name catenated to the process-id

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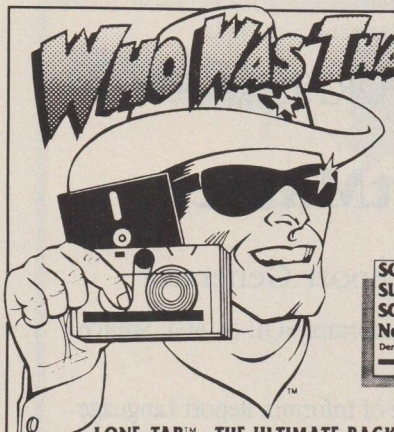

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number of the shell running the script (stored in $$). Previously, line 4 had set a trap to remove this temporary file in case the script is terminated by one of the listed signals. Line 37 renames this temporary file to the original data file name, overwriting its contents. Finally, line 38 tells the operator that the script has completed its job.

What's Posix?

Question: I keep hearing about Posix. What is it?

Thomas Windsky
El Paso, Tex.

Answer: Posix (Portable Operating System for Computer Environments) is an IEEE standard for a portable operating system. You keep hearing about it because the federal government now requires Posix compliance on many of its procurements. Posix grew out of an effort to standardize UNIX by the /usr/group association (now UniForum), and, to a large extent, looks like UNIX. There are 12 Posix working groups, which are listed in Table 1.

TABLE 1: The Posix committee has 12 working groups listed below:

P1003.1 System Services Interface
P1003.2 Shell and Tools
P1003.3 Test Methods
P1003.4 Real Time Extensions
P1003.5 Ada Language Bindings
P1003.6 Security Extensions
P1003.7 System Administration
P1003.8 Networking
P1003.9 Fortran Language Bindings
P1003.10 Supercomputing
P1003.11 Transaction Processing
P1003.12 Interprocess Communication

The only full-use Posix standard today is 1003.1, published in 1988 by IEEE. 1003.1 defines the system services of a Posix-compliant system, which are roughly equivalent to UNIX system calls. If you'd like a copy of the 1003.1, you can contact the IEEE at 202-371-0101.

The Posix standard is currently being created. If you'd like to get involved, contact Ralph Barker, UniForum's Director of Technical Services, at 408-986-8840. □

Guidelines: Obviously, this column won't be of much interest unless you send us your questions. Try to make your questions as general interest as possible, and, please, no questions regarding specific hardware or third-party application packages. State the UNIX system version, if applicable, for the question at hand. Send your questions to Ray Swartz, "Answers to UNIX," c/o UNIX WORLD magazine, 444 Castro St., Mountain View, CA 94041. Or send them via e-mail to:

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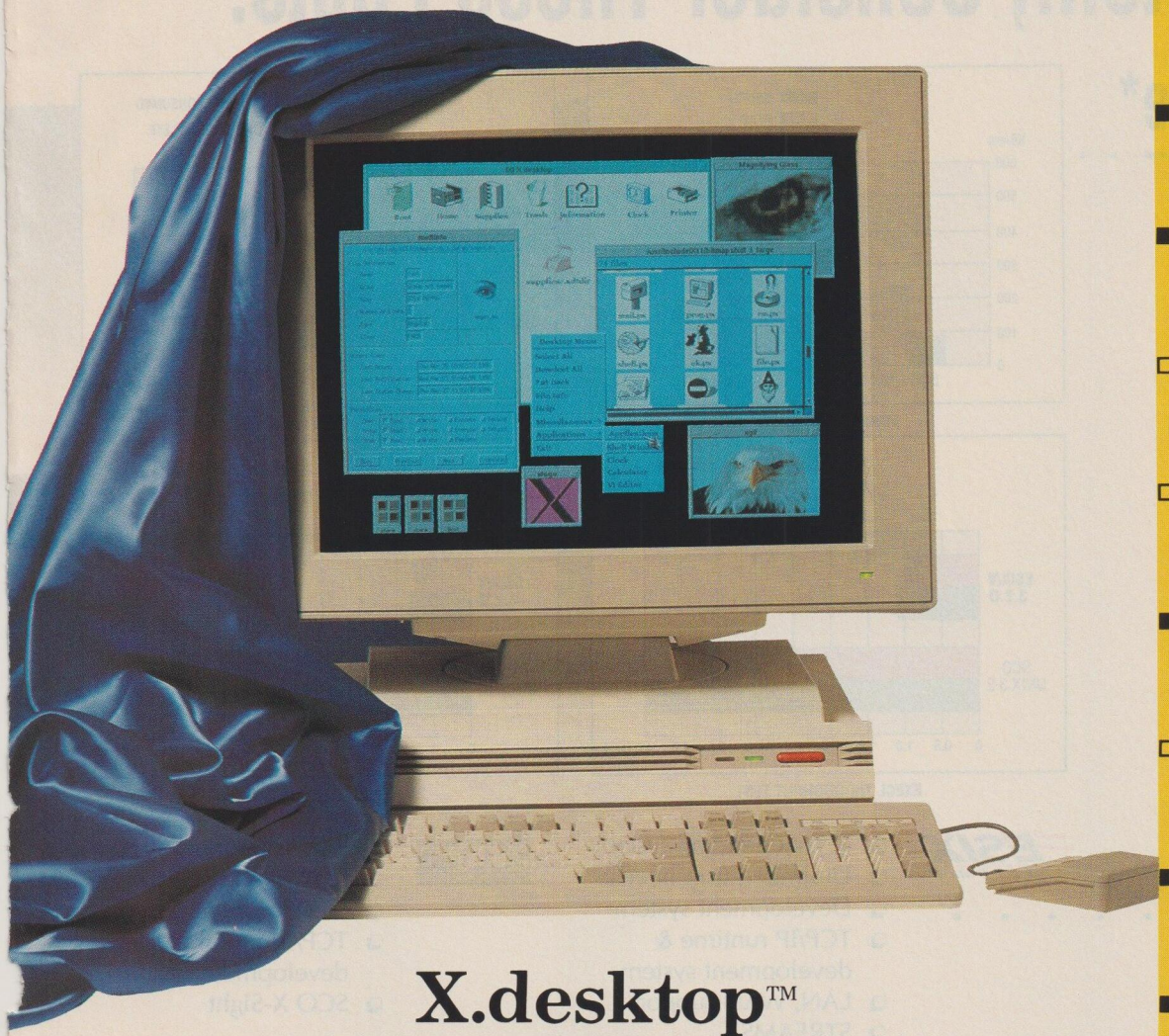

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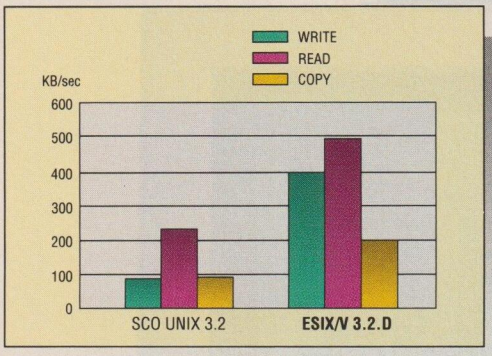

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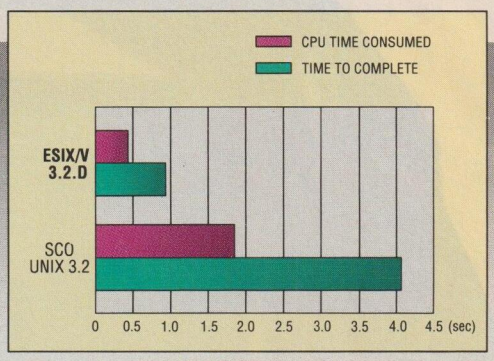

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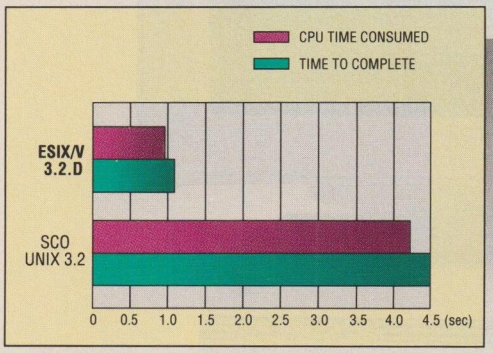

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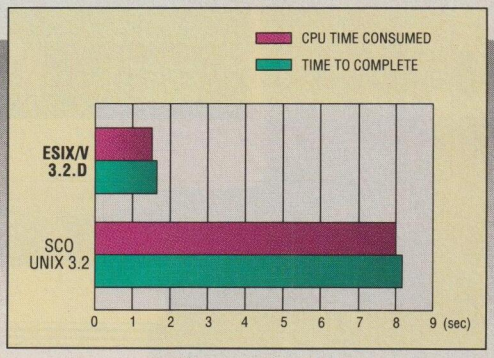

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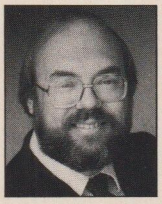
CIRCLE NO. 124 ON INQUIRY CARD

Augie Hansen



EASIER FORMATTING WITH MACROS

Last month I introduced the topic of text formatting and showed some examples of low-level formatting requests used with `nroff`. Using low-level requests in a document source file, however, is a tedious and error-prone activity. Once you use the correct request or group of requests to perform a formatting task, such as indenting a paragraph on the left and right to indicate a quotation, there are many more decisions to make.

For example, if the paragraph won't fit completely on the current output page, should it be split across pages or should it be kept together by moving it to the top of the next page? Another example: if a "begin page" request (`.bp`) falls at the top of a new page, should the request be honored, leaving a blank page, or ignored?

Situations like these occur frequently during document preparation. If you had to write all the logic required to make such decisions into your document source file, you would be working more as a programmer than as a writer. If you succeed, you may justifiably swell with pride over your success as a programmer, but may be distracted from your writing task.

Saving Time with Macros

You need a way to encapsulate the needed logic into easily called high-level formatter requests. To simplify the use of UNIX text formatters, collections of macros can be used to perform many common formatting tasks. A macro is one string, usually a short name, that represents another string that consists of a sequence of formatter requests, often involving some processing logic.

For example, the low-level `.bp` request causes the text that follows it in the source file to be output at the top of the next page. If the request falls exactly at the beginning of a new page, a blank page is produced in the output. The `.SK` macro (skip page) causes a page break, unless it falls at the top of a new page. By using macros, you obviate the need to worry about trifling details such as these. Let the formatter do the work.

Listing 1A shows a way of defining a paragraph macro. In this definition, I have hard-coded a clear line (the `.sp` request) and a first-line indent of a half inch (the `.ti` request). In addition, a "need" request (`.ne`) is used to preclude printing only the first line of a paragraph at the bottom of a page. If there is not enough room for at least two lines, the entire paragraph is moved to the top of the next page. The comments in the listing (introduced by the `\"` token and terminated by the end of the line) describe the purpose of each line in the definition.

To use a previously defined macro, type a dot and the name of the macro at the beginning of a line in the document source file as shown in Listing 1B. As you can see in the formatted output (Listing 1C), each paragraph is separated from previously printed material by a clear line, and the first line of each paragraph is indented further than the other text. A more general paragraph macro might be able to alter its behavior, based on values of arguments passed to the macro or values read from variables.

Each document type has its own characteristic formatting requirements. A simple office memo and a research paper look different from each other and contain different elements. Over time, collections of formatting macros have been developed for various document types. Table 1 identifies a few of the popular macro packages and describes their uses.

Of the macro packages listed in the table, the memorandum macros (MM) are probably the most pervasive and, furthermore, are officially supported by AT&T. The somewhat older manuscript macro (MS) package, also created at Bell Laboratories, is simpler to understand and easier to use than MM. It is quite popular in the research and other technical communities. The other macro packages listed are designed for special purposes, such as creating manual pages, viewgraphs, and permuted indexes. (A permuted index is one that shows the keywords in the contexts of their uses in the indexed document. The UNIX system manuals often have such a keyword-in-context, or KWIC, index.)

Memorandum Macros

In the late 1970s and early 1980s, I supervised a documentation group at Bell Laboratories. Although I thought of it as cruel and unusual punishment, the writers in my group were required to prepare their documents using `nroff` or `troff` formatting requests because we had converted to electronic document preparation and had no WYSIWYG-capable systems at the time—just character-based video terminals connected to UNIX hosts over 1200 bps lines. Virtually all of our material contained MM macros to control formatting.

continued

TABLE 1: Popular text-formatting macro packages

Name	*Description*
mm	memorandum macros - general purpose
ms	manuscript macros - technical papers
man	manual page macros - UNIX manual pages
mv	viewgraph macros - presentation slides
mptx	permuted index - used in some UNIX manuals

Our documents, primarily technical manuals, brochures, and training materials, contained the usual elements: multilevel headings, paragraphs, page headers and footers, footnotes, references, lists, displays, tables, and sometimes mathematical equations. All of these elements and many others, such as tables of contents and indexes, can be handled by the MM package.

Listing 2A shows an example of a document that contains MM macro requests. This document is a simple office memo decrying outrageous telephone expenses. The `.AF` macro specifies the company affiliation. The null argument (`""`) overrides the default (AT&T). You could name your company as an argument. The `.ND` macro allows you to specify a particular date, but if you don't provide one, the current date is used as a default.

Other macros specify the memo title (`.TL`), the author's name (`.AU`), and the memo type (`.MT`). A `.MT 0` (or `.MT ""`) request prints no memo type. Other types include MEMORANDUM FOR FILE (`.MT 1` or simply `.MT`), PROGRAMMER'S NOTES (`.MT 2`), and ENGINEER'S NOTES (`.MT 3`), as well as released-paper style (`.MT 4`) and external-letter style (`.MT 5`). You can set the name to anything you like by using a quoted string instead of a number for the argument (that is, `.MT "NOTICE"`).

Displays

A display is a block of text lines that must be kept together (on a page). For example, you might want to include a listing of source code in a document and want the code to be shown in its entirety on a single page (assuming it is small enough to fit).

A static display (`.DS`) is placed in the same relative position in the output as it has in the input text. If the static display would begin near the bottom of a page and there is not sufficient room for it, some amount of clear lines are output, leaving the page partially blank. Although this is considered unsightly by many editors, it is the right thing to do in some circumstances, typically in computer programming books.

If you don't mind having the display text relocated relative to the main text, you can use a floating display (`.DF`), which automatically moves to the next page if it can't fit on the current page. Some of the text following the display in the source file fills the vacated lines on the current output page before the

LISTING 1: A macro definition associates a name with replacement text.

A. One way to define a "paragraph" macro:

```
.de PG     \" define the name PG
.sp        \" vertical space
.ne 2      \" need 2 lines on this page
.ti .5i    \" indent first line a half inch
..         \" end definition
```

B. Using the macro in a document file:

```
.PG
Time is Mother Nature's way of guaranteeing that
everything doesn't take place all at once.
.PG
Space is Mother Nature's way of making sure that
everything doesn't exist at the same location.
```

C. Formatted output:

```
     Time is Mother Nature's way of guaranteeing
that everything doesn't take place all at once.

     Space is Mother Nature's way of making sure
that everything doesn't exist at the same location.
```

LISTING 2: For preparing general office correspondence and a variety of other documents, the Memorandum Macros package is the tool of choice.

A. The source file for a sample office memo:

```
.AF ""
.ND "August 19, 1990"
.TL
Telephone Use
.AU "T. M. Groff"
.MT 0
.DS
All office personnel and staff
.DE
.P
Please be advised that our telephone charges for the past
few months have been far in excess of projections.
It has come to my attention that many of you make
frequent calls to the NIST line to get the time and
temperature.
.P
Although I appreciate your desire to have your watches
set accurately and your need to dress appropriately for
the current weather conditions, there are cheaper
alternatives than long distance calls to Boulder,
Colorado several times a day.
.P
In addition, calls to many cities are being dialed directly
rather than through our corporate network.
.P
From now on, follow these simple rules regarding the use of
company telephones:
.BL 6
.LI
Use the phones only for company-related business
activities and personal emergencies.
.LI
Determine local weather conditions by looking out the
window rather than tying up the phone lines.
.LI
Use the tie lines to our offices in major
metropolitan areas to place calls to those service areas.
.LE
.P
Thank you all in advance for your cooperation.
.NS
S. L. Ime
Central file
.NE
```

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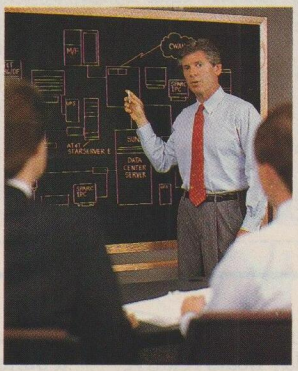

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Listing 2 continued

B. Processing command:

```
$ nroff -mm -Tlp memo.mm | col | lp
$ □
```

C. The formatted memorandum:

```
[-------------------------BEGINNING OF PAGE-------------------------]


      subject:  Telephone Use                  date: August 19, 1990
                                               from: T. M. Groff


      All office personnel and  staff

      Please be advised that our telephone charges for the past
      few months have been far in excess of projections. It has
      come to my attention that many of you make frequent calls to
      the NIST line to get the time and temperature.

      Although I appreciate your desire to have your watches set
      accurately and your need to dress appropriately for the
      current weather conditions, there are cheaper alternatives
      than long distance calls to Boulder, Colorado several times
      a day.

      In addition, calls to many cities are being dialed directly
      rather than through our corporate network.

      From now on, follow these simple rules regarding the use of
      company telephones:

          o Use the phones only for company-related business
            activities and personal emergencies.

          o Determine local weather conditions by looking out the
            window rather than tying up the phone lines.

          o Use the tie lines to our offices in major metropolitan
            areas to place calls to those service areas.

      Thank you all in advance for your cooperation.

      Copy to
      S. L. Ime
      Central file

(Blank lines deleted)

[--------------------------END OF PAGE--------------------------]
```

page is ejected, avoiding the open space. Thus, the display floats relative to its companion text in the source file. Floating text may be appropriate for numbered listings or tables.

Whether you use a static or a floating display, you mark the end of the display text in the source file with a `.DE` request. The lines between the `.DS`/`.DE` or `.DF`/`.DE` pairs comprise the display. The default mode is no-fill (lines are not adjusted) and no indentation from the prevailing left or right margin indentation. You can use arguments to the display-start macro to alter these behaviors.

Making Lists More Useful

Complex descriptions can be made more palatable by using lists to separate components. A wide variety of list types are supported. Let's start with the one used in the sample document—a bulleted list, which is invoked by the `.BL` request. A true bullet symbol (a relatively large filled dot) is used in `troff` processing for a typesetter, but `nroff` simulates the bullet by overstriking the lowercase letter "o" with a plus sign ("+")—simple, but effective. A single numeric argument specifies an indentation other than the default, which is the same as the prevailing paragraph indentation.

Each item in a list is flagged by a `.LI` request, and the list end is signaled by `.LE`. Arguments to the `.LI` requests can be used to override or supplement the current list item mark.

Here are some other types of lists that are supported by MM:

- `.AL`, an automatic list (numbered or alphabetized)

- .ML, a marked list (the user provides a mark, which consists of one or more characters)
- .RL, a reference list (automatically numbered with the digits placed in square brackets)
- .VL, a variable list (each list item is prefaced by a mark that is supplied as an argument to its .LI request)

If what you need is not covered by the list types shown above, you can use the .LB macro to create your own customized list type. (All of the predefined list types use .LB in their list-start macros.)

End-of-Document Elements

Except in the released paper styles, the following end-of-document requests are processed.

A formal closing is provided by the .FC request. You can provide a string argument to customize the closing or accept the default of "Yours very truly," The .FC request, if any, must precede any .SG request. A .SG request prints the author's name(s),

LISTING 3: Specialized formatter programs are provided to process tables (tbl), mathematical symbols and equations (eqn and neqn), and line drawings (pic).

A. A fragment from a document source file that contains a table specification (the -> symbol represents the Tab character, which separates table entries into columns):

```
.TS
box;
C S S
CICIC
LILIL.
Computer Systems and Uses
_
Hardware->System Software->Use(s)
_
Everex 386/20->DOS 4.01+Windows 3.0->Development
->->Accounting
->->Taxes
_
Custom 486/25->SCO Open Desktop->General
->->X Windows development
_
Custom 386/33->OS/2 1.2->OS/2 PM development
->->Communications
_
IBM PC/AT->DOS 4.01->Desktop Publishing
->->Compatibility testing
_
AT&T UNIX PC->UNIX V.3 (3.51)->Electronic mail
->->C++ development
->->General purpose
_
.TE
```

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Listing 3 continued

B. Processing command:

```
$ tbl table.mm | nroff -mm -T1p | col | lp
$ □
```

C. Formatted output:

Computer Systems and Uses		
Hardware	System Software	Use(s)
Everex 386/20	DOS 4.01+Windows 3.0	Development Accounting Taxes
Custom 486/25	SCO Open Desktop	General X Windows development
Custom 386/33	OS/2 1.2	OS/2 PM development Communications
IBM PC/AT	DOS 4.01	Desktop Publishing Compatibility testing
AT&T UNIX PC	UNIX V.3 (3.51)	Electronic mail C++ development General purpose

each offset to the center of the page and preceded by three blank lines for the actual signature(s).

The `.NS`/`.NE` request pair starts and ends notations. These are typically used to provide "copy to" (as shown in the sample memo) and attachment and enclosure information.

Part B of Listing 2 shows the formatter command line we used to obtain the result depicted in Part C of this listing.

Simplify Documents with Tables

Streams of unbroken text are usually boring and often intimidating to readers. You can dress up and simplify your documents by using tables. You can embed table requests within your document source file, but you must use an additional processing program ahead of `nroff` or `troff` to convert the higher-level table description into meaningful formatter input. The UNIX system pipeline facility for mixing and matching programs makes this task easy.

Listing 3A shows the source fragment (not a complete document) that specifies a table. The `.TS` request identifies the table start and `.TE` marks the end. The lines between these requests contain both the textual content and the "graphical" suggestions for the table's appearance.

The general layout of a table specification contains an option list, a format list, and the data to be displayed. A semicolon following the last option terminates the option list. A period following the last format specification terminates the format list.

The `box` option specifies a single-line box around the entire table. It is the only option used in this sample. The first format line specifies that the first data line in the table is to be centered in the table width (`C S S`). The `C` code indicates centering within the column, but the two `S` codes mean "span column" and, together with the first code, effectively turn the first line into a single, wide column with centered text.

The second format line `CICIC` specifies three items centered in their respective columns, separated from each other by single vertical lines. This is the format of our second data line, the column title. The third (and last) format line, `LILIL`, specifies three left-adjusted columns, again with single-line vertical separators. This format applies to the third and any remaining data lines in the table, unless the format is altered by additional requests. The data lines that consist only of an underscore (`_`) specify a single horizontal line separator in the table.

Other possible formats include `R` for right-adjusted text, `N` for numeric en-

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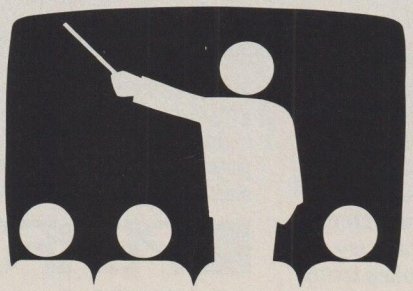

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tries, and A for alphabetic subcolumns. You can use the lowercase equivalents of the format key letters. There are many variations on the table theme that permit you to create tables with nested structures and other complications. If you're serious about building tables, get the detailed documentation on `tbl`, study it, and practice. It will take some "cut and try" to get a feel for building anything more complex than what I have shown here. Also, check out *Typesetting Tables on the UNIX System*, McGilton and McNab, Trilithon Press, 1989, 1990.

Listing 3B shows how the `tbl` preprocessor program is used at the head of a pipeline command. This preprocessor performs the table translation (that is, high-level `tbl` requests are converted to low-level `nroff` requests) and the document and formatting requests are passed onto `nroff`. The kind of output you might get from a typical lineprinter is shown in Listing 3C. Of course, an image printer that can draw lines as vectors can produce a much cleaner-looking table. So can one that contains a set of line-drawing characters in its character set.

Other Formatting Features

In addition to the formatting capabilities described to this point, MM provides macros for repeating page headers and footers, multilevel headings, footnotes, and mathematical equations, just to name a few.

In conclusion, I refer to what I said in the beginning of this text processing series. If you have no choice or have specialized needs, the standard UNIX text formatters may be just the ticket. But if your documentation needs are typical, and you have access to a WYSIWYG document preparation system, by all means use it. I am neither a masochist nor a sadist, so I cannot in good conscience suggest that anyone punish herself or himself unnecessarily by using a text-processing system that is older than dirt and archaic by current standards.

[*Editor's note:* See the sidebar in last month's "New to UNIX" column for a list of several useful text formatter reference documents and books.]

Some Parting Words

This is my last New to UNIX installment. Most of the programming, writing, and training that I do relates to the C and C++ languages, graphical user interfaces, and cross-platform applications development. It is becoming increasingly important that I devote my full attention to those activities.

Thank you all for your interest and support over the past few years. I hope that you have found something of value in the column and that you will continue to enjoy the benefits of using UNIX for a long time to come. □

Augie Hansen is the founder of Omniware, a Denver-based computer consulting and training firm. He is the author of several books on C programming and `vi`. *You can send him e-mail at:*

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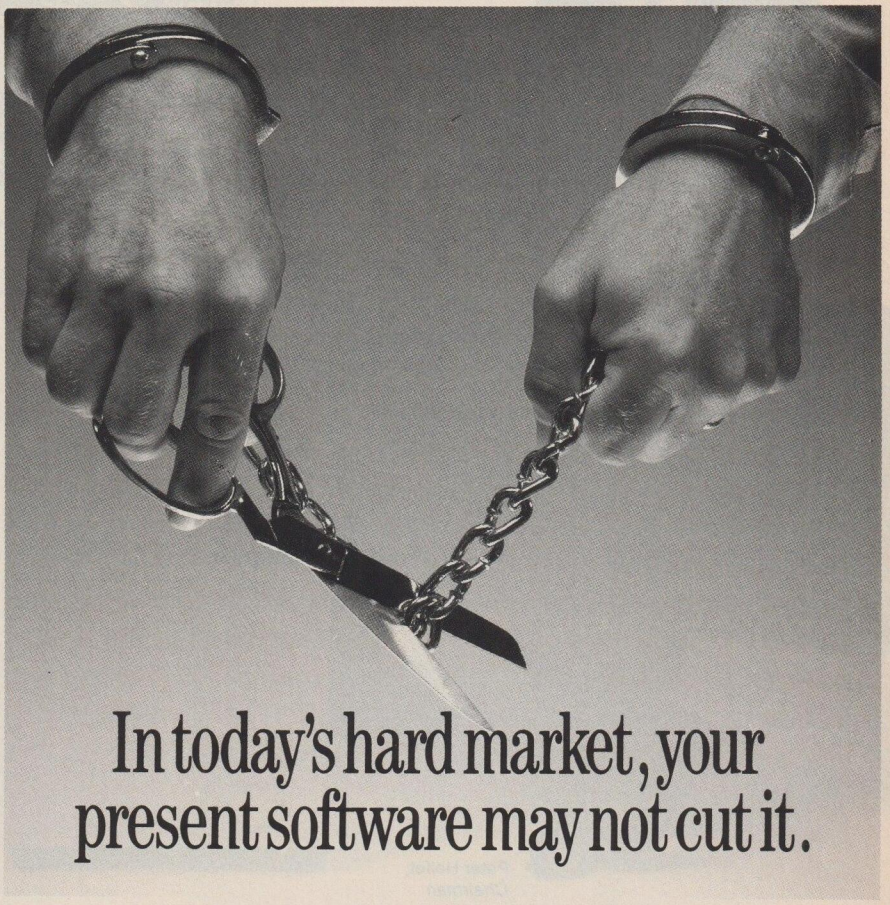

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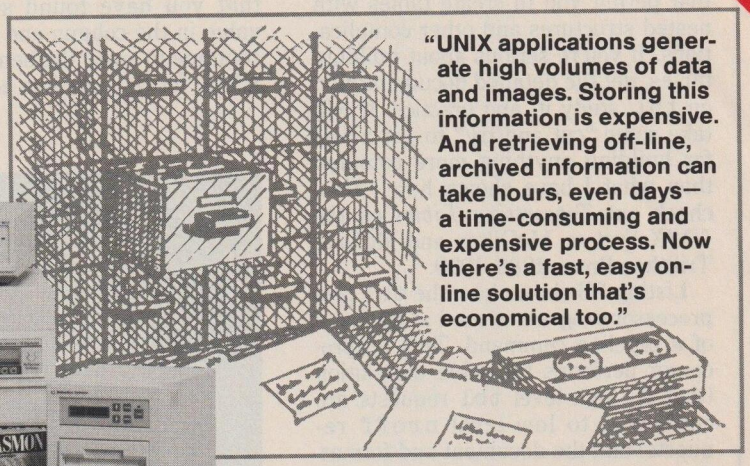

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CIRCLE NO. 25 ON INQUIRY CARD

Howard Baldwin

SOLBOURNE TURNS UP THE HEAT ON SUN

In the last few weeks, Solbourne Computer has rewritten the rules for high-speed, low-cost graphics. It has established a beachhead with Sun-compatible products from X terminals to rackmount servers. There's no letting up of competitive pressure against Sun Microsystems, and that brings new value for your dollar.

Solbourne's new S4000 workstation costs around $17,000, and now includes sophisticated features like a Z-buffer and Gouraud shading. The S4000 competes directly with the SPARCstation 2s.

Workstation analyst Andrew Allison notes, "Solbourne's moving away in a quite dramatic way from being a clone vendor to offering real value-added in the context of graphics capability and configuration of the basic box." As for the S4000 itself, Allison is impressed by its configurability, expansion capability, and, particularly, its graphics performance. He predicts, "Sun is going to be quite upset by this."

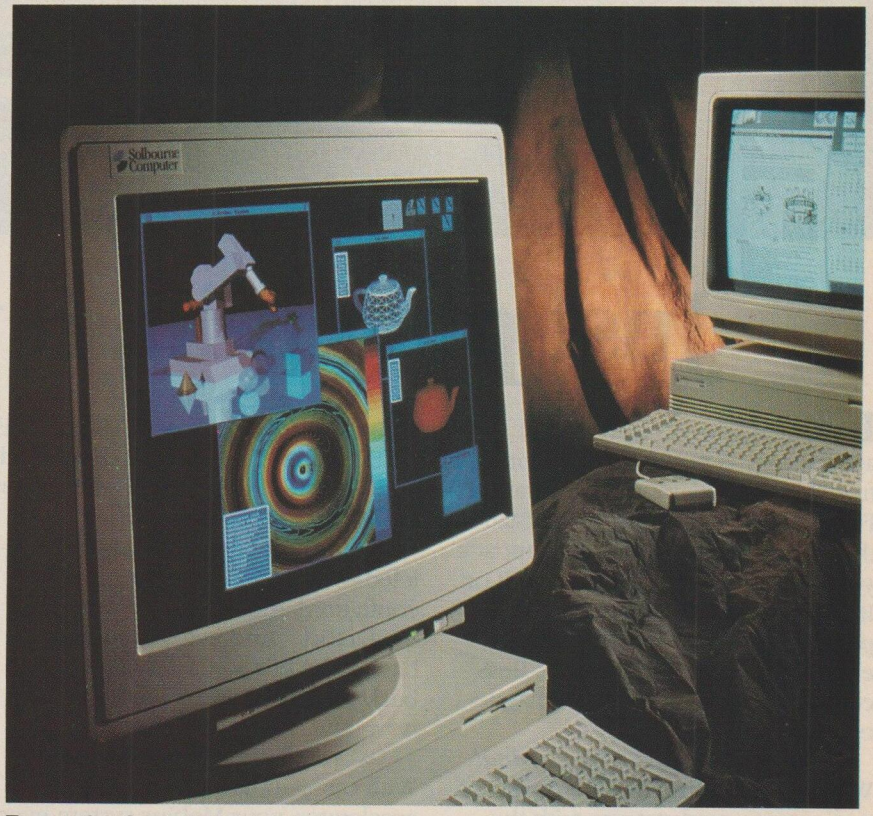
When the SPARCs start flying about the S4000 and the SPARCstation 2, you'll see a lot of specs thrown about. To be sure, Solbourne runs at 33 MHz, and its SPEC benchmark is 12. Sun uses Cypress' new 40-MHz processor, and its SPEC benchmark is 21. Sun already offers 24-bit true color, while Solbourne's is a couple of months off. But as Allison notes, in terms of configurability, you'll find a wider selection with the S4000. Its memory capacity starts at 8 megabytes and goes up to 104 (Sun goes from 16 to 96), while its internal disk storage goes up to 400 megabytes (Sun's only goes to 207).

There are more interesting differentiations. On the S4000's 9-by-11-inch system board is Solbourne's 64-bit proprietary high-speed memory bus, the memory itself, I/O subsystem, and, perhaps most important, Panasonic's MN10501 SPARC chip. The MN10501 is highly integrated, incorporating for the first time several essential elements on one chip. The integer CPU, floating point, memory management, instruction cache, and data cache responsibilities have all been integrated to work in parallel and transfer data in 64-bit segments. Solbourne has also included four ASICs to work with the SPARC chip. Solbourne estimates that the iGLU ASIC chip, for one, takes the place of 31 miscellaneous logic chips.

Solbourne has also developed some unique S-Bus graphics options for the S4000. The S-Bus is for peripheral and graphics processing, while the proprietary bus (essentially, Solbourne's multiple-board K-Bus is now on a single board) is for internal processing. Installing the dual-slot Solbourne SGA (S-Bus graphics accelerator) card accelerates both 2-D and 3-D graphics, but you can also add a daughterboard to the SGA for Z-buffer capability. Z-buffering allows you to remove hidden pixels at a faster rate. The SGA board contains three Solbourne ASICs and a proprietary video RAM that accelerates graphics.

At the bottom of the line, with a monochrome monitor, the S4000 starts at $8,995. Add $2,500 for color, another $2,500 for the graphics accelerator, and $3,000 for the Z-buffer daughterboard (total: $16,995). **Solbourne Computer, 1900 Pike Rd., Longmont, CO 80501; 800-356-8765 or 303-772-3400.**

Circle No. 301 On Inquiry Card



Targeted at Sun's SPARCstation 2, Solbourne's S4000 runs at 33 MHz and features Gouraud shading and a Z-buffer capability.

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CIRCLE NO. 24 ON INQUIRY CARD

WITH THIS TOKEN RING I THEE WED

In its ongoing efforts at matchmaking between IBM SNA (Systems Network Architecture) and TCP/IP networks, Mitek Systems has created two communication gateways, the M2533 Token Ring server and the M2133 SDLC server. With the M2533, you can link TCP/IP systems on Ethernet with devices on a token ring network using IBM's APPC and APPN (advanced peer-to-peer communications or networking) protocols and communicate bidirectionally. You can use native-mode communications on either side of the network: IBM data streams on one side, and VT100, VT220, and VT52 emulation on the other via either Telnet (terminal emulation) or FTP (file transfer).

The M2133 acts both as a gateway and a protocol converter, providing SNA access via the SDLC (synchronous data link control) protocol. This lets you access mainframe environments from local or remote Ethernets through a front-end processor at speeds up to 256 kilobits per second.

Both servers use both 386 and dual 68000 processors. Price for the SDLC version is $11,450 for a 16-session model; the 128-session model is $16,450. For Token Ring, the systems range in price from $13,450 to $18,450. Mitek has also made its OpenConnect/Presentation Services terminal emulation software compatible with AS/400 Release 3, so that via the latter's Telnet support, users on UNIX hosts can access the AS/400 via 3270 terminal emulation. **Mitek Systems, 2033 Chennault Dr., Carrollton, TX 75006; 214-490-4090.**

Circle No. 302 On Inquiry Card

Swinging On A Stardent

Contributing to the big swing to low-cost desktop graphics (such as Sun and Solbourne) is Stardent, with its Stardent 500 Stiletto series. On it you can use Stardent's AVS (application visualization system), which lets you visualize and interact with data without having to resort to graphics programming. It uses several RISC chips working together: a 32-MHz MIPS R3000 integer chip, a MIPS R3010 scalar floating-point chip, an Intel i860 for vector instructions, and two other i860s for true-color pixel and polygon processing.

Stardent estimates 32 mips and 48 peak megaflops per processor (twice the power at 20 percent of the size and 50 percent of the price of a two-year-old graphics supercomputer). All the software that runs on Stardent's 3000 series will also run in the Stiletto, which comes in one- or two-processor models. Cost begins at $17,900 for a diskless, single-processor OEM (original equipment manufacturer) version, and goes up to $70,000 for a fully configured dual-processor end-user machine. You can get what Stardent considers an average configuration for $39,000: single processor with 16 megabytes of memory, 250 megabytes of disk storage, 120-megabyte internal tape storage, and 16-inch color monitor.

Stardent is also incorporating its VX graphics subsystem to create the 3000VS series. You can upgrade your 3000 series by installing the subsystem, composed of 24 custom ASICs (application-specific integrated circuits); it implements in hardware what most graphics systems do in software. You can use the 3000VS for image realism and faster visualization of 2-D, 3-D, and volume data, and construct highly realistic scenes using texture mapping, real-time composition, and multipass transparency. The Stardent 3000VS ranges from $100,000 to $300,000, depending on configuration; the field upgrade for current users is $30,000. **Stardent, 95 Wells Ave., Newton, MA 02159; 617-964-1000.**

Circle No. 303 On Inquiry Card

Seven Luscious Layers From NCR

Each of the seven levels of NCR's System 3000 new product line has a different flavor, ranging from portables at the 3100 level to enterprise-wide machines at the 3700 level. They are all based on the Intel processor instruction set, and will run UNIX System V.4, SCO UNIX, OS/2, and DOS, support SCSI and Micro-Channel interfaces, and, ultimately, cover single-processor, tightly coupled multiprocessor, and loosely coupled parallel processing designs. Stay tuned for most of those announcements. Currently available, though, are six machines: three at the 3300 level, two at the 3400 level, and one at the 3500 level.

At the 3300 level are the 3320, 3340, and 3345 machines based, respectively, on the 20-MHz 386SX, the 25-MHz 486, and the 33-MHz 486, ranging in price, based on memory and storage configuration, from $4,000 to $60,000.

At the 3400 level are the 3445 server, based on the 33-MHz 486, and the 3450 server, using from one to four 50-MHz

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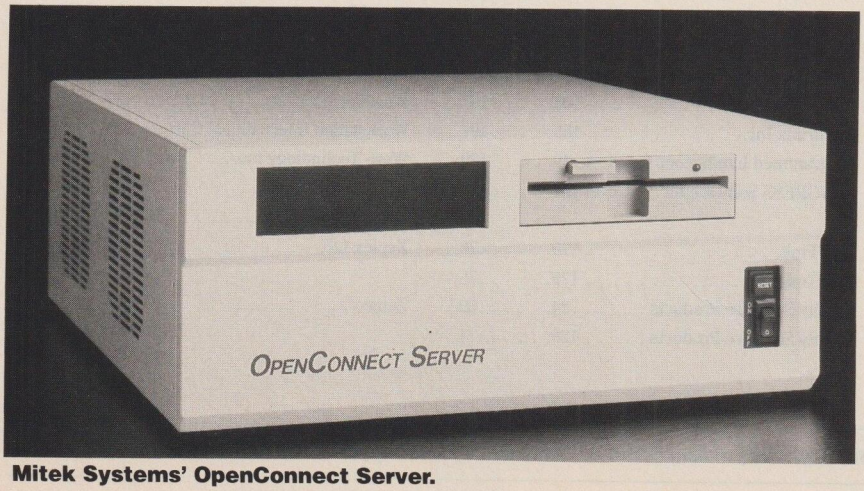

Mitek Systems' OpenConnect Server.

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UPCOMING SHOWS

DEXPO West '90: December 11-13
DEXPO West is a computing and connectivity exhibition for users of networked multivendor systems. Aimed at DEC users, the show will feature the latest Mac-to-VAX integration solutions. Multivendor integration, software compatibility, emulation and windows, disk drives, and spreadsheets are other products the show will feature. Over 300 vendors of more than 15,000 products and services are slated to exhibit. The conference will be held at the Las Vegas (Nev.) Convention Center and Mirage Hotel. Contact Miller Freeman Expositions, 617-232-3976.

Winter 1991 Usenix Technical Conference: January 21-25, 1991
At this event, leading experts will focus on the beginning and development of the UNIX operating system. The conference is based on such themes as system administration, security, and networking. It also includes a wide variety of tutorials and technical sessions. Technical UNIX subjects to be covered include operating systems of the future, applications, user interfaces, programming environments and languages, and testing and debugging. The conference is aimed at software professionals and technical managers. It will be held at the Grand Kempinski Hotel, Dallas, Tex. Contact Judith DesHarnais, Usenix, 714-588-8649.

UniForum 1991: January 22-24, 1991
This year, the UniForum conference revolves around the theme, "Open Systems Roundup." C. Michael Armstrong, chairman and president, IBM World Trade, will deliver the opening keynote address on the topic of open systems today. Other keynoters include Walter De Backer, director of informatics for the European Economic Community, and Dr. Arno Penzias, vice president of research for AT&T Bell Labs.

The annual industry conference will feature 30 panel sessions on 5 main topics: Network Computing, Portability, Futures, Commercial Requirements, and MIS Considerations. In addition, there will be tutorial workshops, free UNIX system introduction workshops, and plenary sessions, each featuring a panel of industry leaders. The plenary panels will discuss "Creating a Mass Market for UNIX," "Open Systems Impact," and "UNIX in Commercial Markets." More than 250 vendors are scheduled to exhibit and demonstrate UNIX systems, hardware, software, and services. The conference will be held at the Infomart, Dallas, Tex. Contact Susie Gray, PEMCO, 800-323-5155 or 708-299-3131.

Network Computing Forum:
January 28-31, 1991
This high-level, technical conference premieres for senior managers building large enterprise information systems. Attendees come from such management areas as networking, MIS, corporate, data communications, telecommunications, financial, and engineering. Classes are offered in databases; distributed computing; and LAN-WANs, including applications and cost-saving in networking. On the agenda will be LAN interconnecting; computer and mainframe personal computer applications; educational workshops; and technical conferences on such topics as managing the migration to new software environments, centralized management of network computing, partnering of vendors and users, the impact of network computing on MIS, and a five-year forecast for network computing applications.

Keynote speakers scheduled include T. Travers Waltrip, vice president, telecommunications, The Travelers insurance company; Esther Dyson, president, EDventure Holdings Inc., and publisher of Release 1.0; Dr. Dixon Doll, founder, chairman, and CEO of the DMW Group; Peter E. Brown, manager, corporate telecommunications at Digital Equipment Corp.; and Dr. Howard Frank, chairman, Network Management, Inc. The conference will be held at the Grand Hyatt Hotel, Washington, D.C. Contact Christine Krajewski, 508-820-8126.

Communication Networks '91:
January 28-31, 1991
This show is targeted for users and vendors in the information and communications market. The topics and tutorials discussed will include T1/T3; electronic messaging; EDI; network management; next generation network architecture; LAN design; wireless networks; client-server computing; open systems interconnect (OSI) architecture and technology; systems network architecture

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486s with multiprocessing capability. The 3445 can support up to 3.3 gigabytes of internal storage and up to 64 megabytes of memory, and can link up to 128 connections to the server, and, again based on configuration, ranges in price from $20,000 to $85,000. The 3450 offers up to 256 megabytes of memory and 6 gigabytes of storage, and can link up to 256 connections. Prices range from $35,000 to $200,000, with initial availability slated for the second quarter of 1991.

The 3550 is a symmetric multiprocessing mainframe-class system, utilizing NCR's new multiprocessor operating system and incorporating from two to eight 50-MHz 486 processors. It can support more than 1,000 direct connections, and ranges from $100,000 to $800,000. **NCR, 1334 S. Patterson Rd., Dayton, OH 45479; 513-445-5000.**

Circle No. 304 On Inquiry Card

Powerports Sport

While you could expand Consensys' eight-port multiport cards to 16 ports by adding a daughterboard, you can now take the new 16-port intelligent I/O card in its Powerports/HD series and expand it with daughterboards for either 32 or 48 ports in a single PC slot. The boards come in two versions: with 512K of RAM, or with two megabytes of RAM. With the latter comes PowerView multiscreen software, which gives you the ability to view up to eight screens on any terminal (if you have a terminal that supports multiple paging, the 512K card is sufficient).

Each card has a 15-MHz, 32-bit NSC32000 chip set on-board running a multitasking real-time communications operating system, so that you can off-load serial communications from the CPU of the PC (either AT or EISA bus). RJ45 connectors are standard, DB9 connectors are optional. Cost for the 512K boards are $1,595 (16 ports), $2,590 (32 ports), and $3,290 (48 ports); for the 2-megabyte boards, it's $2,140 (16 ports), $3,135 (32 ports), and $3,735 (48 ports). **Consensys, 250 Shields Ct., Ste. 10-B, Markham, ON L3R 9W7; 800-387-8951 or 416-940-2903.**

Circle No. 305 On Inquiry Card

Accessing CD-ROM

Micro Design International has devised a way for UNIX users to access DOS-based CD-ROMs with its SCSI Express software, opening up an extensive library of information. Emulating a read-only mountable UNIX file system, SCSI Express can use standard file system commands, such as `ls`, `cat`, `cp`, and `fsck`. The DOS programs that come with the CD-ROMs can be used under the VP/ix environment.

The SCSI Express interface supports High Sierra Group and ISO-9660 formatted CD-ROMs, and up to seven SCSI CD-ROM drives connected to the system. The software also contains the necessary drivers to support disk, tape, digital audio tape (DAT), rewrit-

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able optical, and write-once, read-many (WORM) under UNIX. It is available for SCO, Interactive, and AT&T's PC-based UNIX operating system software at a cost of $495. **Micro Design International, 6985 University Blvd., Winter Park, FL 32792; 407-677-8333.**

Circle No. 306 On Inquiry Card

Planting The Open Sesame Seed

While the Open Software Foundation and UNIX International have graphical user interfaces (GUIs) for entire operating systems, Xecute has taken a different tack–its Open Sesame is a GUI solely for AutoCAD for UNIX. As long as you also have Visix's Looking Glass desktop manager, Open Sesame works the same way as any other GUI–you can double-click on icons for each AutoCAD file and access editing and printing commands, or create a DXF file. Cost is $399 for Apollo DN, DECstation, HP 9000, Motif, SunView, or X Windows-based workstations. **Xecute, 1115 Inman Ave., Edison, NJ 08820; 800-468-1115 or 908-668-5151.**

Circle No. 307 On Inquiry Card

Priam Tosses Out More Disk Drives

In its first entrance into the 3.5-inch disk drive market, Priam Systems offers full-height drives with 200 megabytes of storage and adapter cards for UNIX and XENIX aftermarkets. The ID200L drives feature a 15-millisecond seek time, and are AT- and BIOS-compatible. Available in three models, the ID200L-IC ($1,551) includes an IDE (AT drive interface) and floppy adapter; the ID200L-IF ($1,531) works with fixed disks; and the ID200L-I ($1,500) works with systems that use an embedded IDE adapter. **Priam Systems, 1140 Ringwood Ct., San Jose, CA 95131; 408-954-8680.**

Circle No. 308 On Inquiry Card

Bringing the Bernoulli Box To UNIX

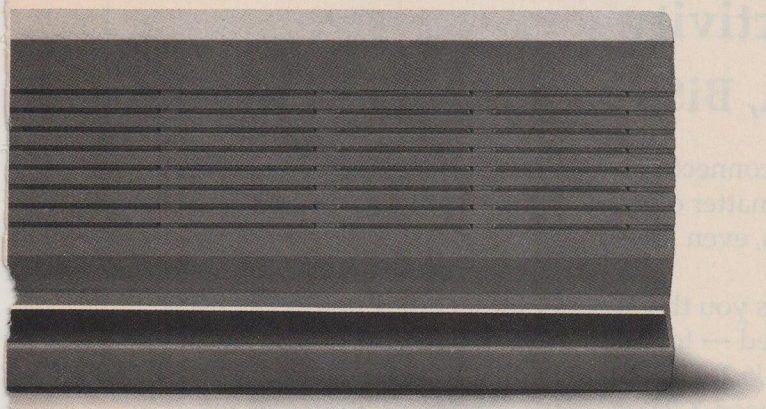
For a long time, PC users have had high-speed, random-access, removable mass storage with Iomega's Bernoulli disks, also known as a Bernoulli box, with 44 megabytes of storage. Iomega has developed a package of drivers for UNIX that allow its products, from its oldest 8-inch drives to its new 44-megabyte 5 1/4-inch drives and LaserSafe rewritable optical drives, to run with SCO's and AT&T's System V/386 3.2. Cost of a driver is $99. **Iomega, 1821 West 4000 South, Roy, UT 84067; 801-778-1000.**

Circle No. 309 On Inquiry Card

Sun Rolls Out The Newsprint

Taking the processing out of the printer and putting it back into the host device, Sun has developed Newsprint, printer software designed to implement PostScript compatibility in a variety of output devices, from dot matrix, ink jet, laser, and color thermal printers to plotters. Included in Newsprint are 57 brand-name, scalable, outline fonts made using Sun's own F3 font format;

HE LEADER



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CIRCLE NO. 123 ON INQUIRY CARD

more than 700 additional fonts are available from other font suppliers. Cost of the software is $495.

Sun also unveiled its latest printer, the SPARCprinter, which appropriately leaves the processing power to the SPARC CPU. Top speed is 12 pages per minute with a software-selectable resolution of 300 to 400 dpi (dots per inch). It attaches to the SPARCstation via an S-Bus card that contains a SPARCprinter port and a Centronics parallel port. Cost, including card and cables, is $2,695; S-Bus printer card purchased separately is $695. **Sun Microsystems, 2550 Garcia Ave., Mountain View, CA 94043; 415-960-1300.**

Circle No. 310 On Inquiry Card

dBase IV Rises On The Sun

Following in the footsteps of its historical spreadsheet counterpart, Lotus 1-2-3, one of the DOS software packages that helped make PCs a success, Ashton-Tate's dBase IV software has made the transition to the Sun. As an integrated 4GL (fourth generation language) software package, it combines a database management system with application development language with easy programming and productivity tools. It features the same look-and-feel of the DOS version, and you can run DOS-based files on your SPARCstation.

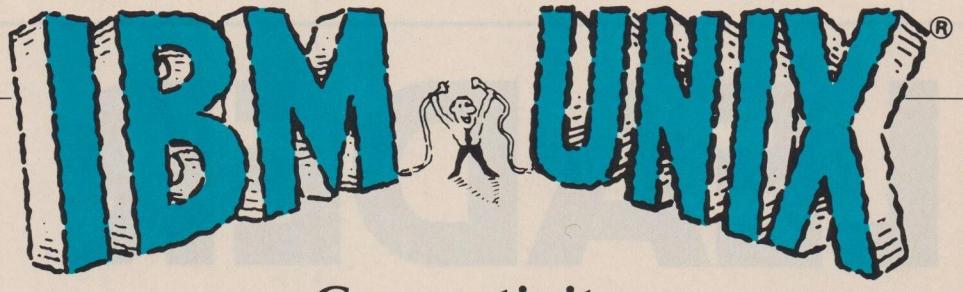
While you may need to run some data conversion on dBase applications, dBase source files, data files, and compiled object files are compatible across DOS and UNIX systems. The 4GL tools allow you to create objects such as screens, reports, views, menus (whether pop-up or pulldown), and sign-on banners. Other features within the 4GL tools include an automatic code generator, a template language, a symbolic debugger, and dBase IV utilities. dBase IV for Sun starts at $995 for a single-user license; a multiuser package, adding up to four users, costs $2,995. Single-user and four-user runtime licenses cost $395 and $995, respectively, and additional documentation is $195. **Ashton-Tate, 20101 Hamilton Ave., Torrance, CA 90502-1319; 213-329-8000.**

Circle No. 311 On Inquiry Card

Solarix Energy

Joining the parade of SPARC-compatible workstations is Solarix Systems, with the Solarix/4 PW+ workstation. As with many workstations, its goal is scalability, but in this case you do it by switching a credit card-sized processor module, not a board. The basic A-module runs at 18 mips, with upgrades available up to 40 mips. The Solarix/4 has both 32-bit S-Bus slots, and the 64-bit SPARC Mbus that supports the processor upgrades. Memory ranges from 8 to 32 megabytes, added via industry-standard SIMMs.

The desk-side tower has an internal peripheral bay for up to six half-height peripherals so that the desktop doesn't become cluttered with shoeboxes. The desktop box has integrated interfaces for both thin and thick Ethernet, but also



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New York, NY 10001

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CIRCLE NO. 100 ON INQUIRY CARD

What does the company that revolutionized tape storage do for an encore?

5-Gigabyte Capacity.

EXABYTE's next generation of 8mm cartridge tape subsystems advances beyond the performance and capacity that made the EXB-8200 the *de facto* data storage standard in today's workstation, UNIX® and file server environments.

Employing read and write head pairs, the **EXB-8500 8mm Cartridge Tape Subsystem** provides over ***5 gigabytes*** of storage capacity on a single 8mm tape while achieving an extraordinary data transfer rate of ***500 Kbytes/second***. That means a 760 megabyte disk drive may be backed up in approximately 25 minutes! And high speed search up to ***37.5 Mbytes/second*** allows rapid file retrieval.

Extending the limits of unattended backup and data interchangability, the EXB-8500 is capable of reading and writing data in the EXB-8200 format. In addition, we've added features for data acquisition applications.

Designed to meet the growing demands of super-mini and mainframe computer systems, the EXB-8500 is the perfect encore for today's data intensive storage requirements.

If you're an OEM, VAR, or systems integrator, call us today at **(303) 447-7359** or write EXABYTE Corporation at 1685 38th Street, Boulder, CO 80301.

CIRCLE NO. 62 ON INQUIRY CARD

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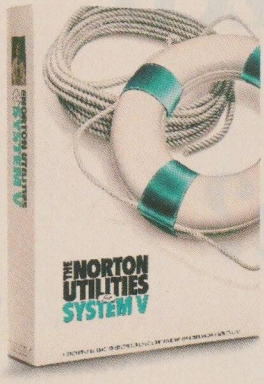
USE IT OR LOSE IT.



Now goodbye doesn't have to mean forever. Introducing The Norton Utilities* for System V.†

Developed jointly by INTERACTIVE Systems, Segue Software and Peter Norton Computing, The Norton Utilities for System V brings to the UNIX* system environment the safety and comfort that hundreds of thousands of DOS users already enjoy.

With Norton UnErase*, you can quickly recover deleted files and directories given up for lost. Just a few keystrokes turn what could have been a major disaster into an easy fix. And you can do it all from the system console or any terminal on a UNIX system.

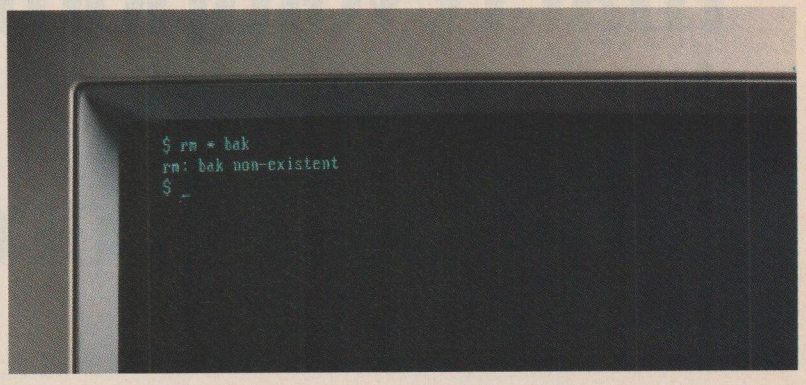
But suppose the problem is more serious—like a corrupted file system? Well, with Norton's Disk Explorer* you can diagnose and repair corrupted files and disk structures even when everything looks hopeless. And get back data you thought was lost without re-keying a thing.

Of course, there's more than just disaster relief. The Norton Utilities for System V is a standard set of 18 utilities that make the UNIX system environment easier to work with. And at just $295 per CPU, it's the kind of security that will quickly pay for itself.

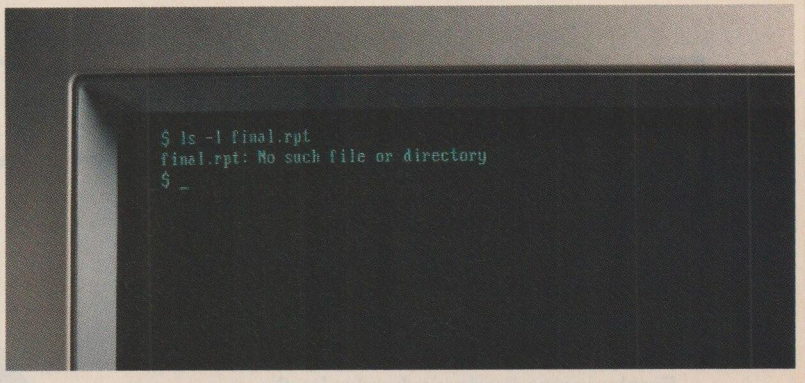
For more information and a free brochure, call 1-800-346-7111; in Europe call 44-494-472900. After all, what do you have to lose?

INTERACTIVE

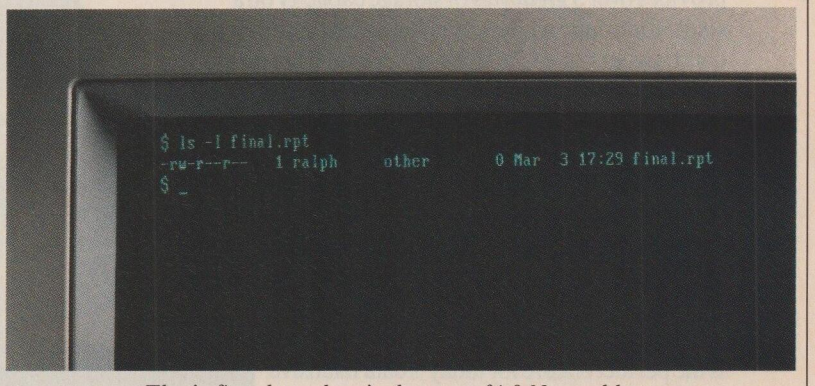
A Kodak Company



Oops! There goes the directory. But don't worry. You can bring it all back with Norton UnErase.



What happened to that file? Cheer up. Norton UnErase will track it down and recover it.



That's fine, but where's the rest of it? No problem. Norton UnErase will resurrect the missing parts.

THE NORTON UTILITIES FOR SYSTEM V. NOW ALSO AVAILABLE FOR SCO™ UNIX USERS.

†Available for INTERACTIVE UNIX System V/386 Release 3.2 and AT&T's UNIX System V/386 Release 3.2 *UNIX is a registered trademark of AT&T in the United States and other countries. The Norton Utilities and UnErase are registered trademarks, and Norton Disk Explorer is a trademark of Peter Norton Computing, Inc. Kodak is a registered trademark of the Eastman-Kodak.Company. SCO is a trademark of the Santa Cruz Operation,Inc.

CIRCLE NO. 67 ON INQUIRY CARD

has a Centronics parallel interface so that you can plug in a printer solely for that user. The $6,995 cost is for a diskless unit with 8 megabytes of RAM and a 17-inch monochrome monitor; 19-inch monochrome and 17-inch color monitors are also available. **Solarix Systems, 46791 Fremont Blvd., Fremont, CA 94538; 415-659-1544.**

Circle No. 312 On Inquiry Card

Music To Your Workstation's Ears

Symmetrical Technologies' STOS-JB, a 5 1/4-inch erasable optical jukebox subsystem, links to Sun, DEC, and Macintosh computers via their SCSI port. Encompassed in the subsystem is one or two ISO-compatible drives, software for jukebox control and transparent integration, and cabling; for DEC Q-bus-based computers, a SCSI host adapter is also included.

The software allows you to look at the jukebox as multiple disk drives, and the number of drives you see corresponds to the number of media surfaces contained within the jukebox. You can logically mount them simultaneously, for instance, for rapid access to any file. A management utility governs media import/export, mapping, and status information. Price starts at $37,000. **Symmetrical Technologies, 301 Gallaher View Rd., Ste. 231, Knoxville, TN 37919; 615-690-3838.**

Circle No. 313 On Inquiry Card

SGI Now Visualizes The Network Outside The Computer

Silicon Graphics' NetVisualyzer software helps you monitor network activity from data stations in remote sites, letting you communicate to a central network display station over the Internet Protocol (IP) or via serial-line modems, X.25, fiber optics, T1 telecommunication lines, or even microwave links. NetVisualyzer provides network monitoring tools to create a picture of the network, using the machine's visual processing capabilities to map network configuration, check real-time traffic patterns, and identify security breaches.

Between the central display station and the remote data collection stations elsewhere on the network, NetVisualyzer monitors three levels of network architecture: traffic and configuration, statistical summaries, and packet level diagnostics. NetSnoop, the data collection tool, captures packets for analysis by two other tools, NetLook (which visually represents traffic patterns) and NetGraph (which graphics traffic into bar charts). You can also gather packet level diagnostics by packet number, time, packet length, source or destination address, or protocol type. NetVisualyzer supports Ethernet-based networks and TCP/IP, NFS, DECnet, DNS, Cray, IP, ICMP, IGMP, and RIP protocols. The NetVisualyzer software for the central display station is $8,000; for each remote data station, it's $4,000. Each station requires eight megabytes of RAM and 200 megabytes of storage. **Silicon Graphics, P.O. Box 7311, Mountain View, CA 94039; 415-960-1980.**

Circle No. 314 On Inquiry Card

More Low-Cost Graphics (Relatively)

Your options in low-cost graphics workstations are also being embellished by Evans & Sutherland, whose ESV3 workstation relies on VLSI chips for antialiasing and real-time motion. Other graphics features include 24-bit double-buffered color bitplanes, depth-cueing, and support for PEX (the PHIGS extension to X). Using the MIPS R3000 chip, the ESV3 runs at 20 mips and 4 megaflops, with up to 525,000 vectors per second and up to 28,000 polygons per second. Basic configuration is 8 megabytes of RAM, a 180-megabyte hard disk, and a 150-megabyte tape drive, at a price of $29,900. **Evans & Sutherland, 600 Komas Dr., Salt Lake City, UT 84108; 801-582-5847.**

Circle No. 315 On Inquiry Card

This Patton Is Specific, Not General

Patton Electronics' Model 1005 asynchronous short-range modem is specifically designed for the UNIX marketplace in which the host waits for a terminal to send its DTR (data terminal ready) signal. After the DTR signal is received, then the host sends the log-in screen. The "carrier sense" 1005 modem sends the DTR signal as soon as the terminal is turned on. You can also use the modem in troubleshooting, because any break in the data line will make the DTR signal go negative.

The Model 1005 also works in conjunction with other short-range modems; with the Model 1004, it controls signals between printers and hosts. The Model 1005 requires no AC power and runs at speeds up to 19.2 kbps at distances up to 17 miles over two twisted pair; cost is $80. A surge protected version is also available. **Patton Electronics, 7958 Cessna Ave., Gaithersburg, MD 20879; 301-975-1000.**

Circle No. 316 On Inquiry Card

I'll Print Alone

Iris Graphics' SmartJet 4012 ink jet color printer encompasses four automatic subsystems to decrease operator intervention. After the command comes from the host to print, the printer takes a sheet of 12-by-18-inch paper from the cassette, wraps it around the printer drum, prints, ejects the final copy, cleans the internal deflection structure to keep the nozzles lubricated, and then automatically checks its calibration. Running with UNIX workstations and other electronic prepress systems, the SmartJet 4012's end-user, quantity-one price starts at $39,000. **Iris Graphics, 6 Crosby Dr., Bedford, MA 01730; 617-275-8777.**

Circle No. 317 On Inquiry Card

Emulex In The Chips

Emulex's new FAS200 (Fast Architecture SCSI) chips provide fast SCSI data transfers to facilitate SCSI II support and sustained synchronous rates of 10 megabytes per second, while reducing SCSI protocol overhead. Offering pin compatibility and upward firmware compatibility with existing ESP200 units, the FAS200 features on-chip sequencers for fast bus timing and data transfers, parity pass-through, high speed DMA channel data bursts, and pipelined command and data transfer counter (24 bits) for linked SCSI operations. Prices for the FAS200 are $22.30/unit in the 68-pin PLCC and $27.50/unit in the 80-pin PQFP (quantity 1,000). **Emulex Corporation, 3545 Harbor Blvd., P.O. Box 6725, Costa Mesa, CA 92626; 714-662-5600.**

Circle No. 318 on Inquiry Card

Portals To The World

Between UUCP, linking 10 million UNIX users, and Usenet, where 600,000 people all over the world share their thoughts on over 1,200 different subjects, that's a lot of communication. The problem for some users is finding what's known as a "friendly site" to route calls through, and with network traffic up, they're getting rarer. Portal Communications has devised a way around this, with low-cost access via its Basic UUCP Connection. Via this connection, you can send and receive both mail and Usenet feeds

through modems or dial-up phone lines. You can also specify which newsgroups you want, and program your machine to connect to Portal periodically, or have Portal contact you when there is traffic for your site.

If you don't have in-house UNIX expertise, you can apply for Portal's Supported UUCP Connection, providing the basic connection plus access to Portal's engineering staff for instruction, support, and troubleshooting. Prices for the basic and supported connection are $34.95 and $95 per month, respectively, and $1.95 per hour connect time. With a feed of standard newsgroups and an average flow of mail, the cost per month for the basic service should range from $100 to $200. Also available is the UUCP Start-Up Kit for $595, a tape of the necessary software to implement the exchange of mail and news, plus installation instructions (so you don't have to find them yourself in the public domain). **Portal Communications Company, 10385 Cherry Tree Ln., Cupertino, CA 95014; 408-973-9111.**

Circle No. 319 on Inquiry Card

A Developer's Bundle Of Joy

Interactive Development Environments (IDE) has bundled together under a common user interface an integrated C Development Environment, designed to support UNIX C software developers through the entire development process from analysis to re-engineering. Combining the attributes of IDE's Software through Pictures (for analysis and design), Saber-C (for construction, testing, and engineering), FrameMaker or Interleaf TPS CorePlus (for documentation), and IDE training and consulting, the C Development Environment is designed to help software developers maintain existing systems as well as create new applications.

Depending on the configuration, Software through Pictures' single license price ranges from $5,000 to $21,000. Additionally, single license prices for Saber-C, FrameMaker, and Interleaf TPS CorePlus are $2,500 each. **Interactive Development Environments, 595 Market St., 10th Floor, San Francisco, CA 94105; 800-888-IDE1 or 415-543-0900.**

Circle No. 320 on Inquiry Card

Internetworking LANs and WANs

Using Digital Technology's PC-based DTIX3270 multiprotocol software, you can emulate IBM's 3174/3274 controllers and, with an AT-based PC, provide X.25 gateways for connecting local-area networks to remote hosts. With its UNIX/XENIX interface, you can develop applications-specific communication subsystems to link local multiuser systems to wide-area networks.

The DTIX3270 software supports concurrent DOS and 3270 sessions, multiple host sessions with the ability to "hot key" back and forth, user-selectable keyboard mapping, IBM's IND$FILE transfer, and standard application programmatic interfaces such as EHLLAPI and PSAPI. List price for the complete package, including controller card, is $995. Licensing fee for source code starts at $40,000. **Digital Technology, 43 Third Ave., N.W. Industrial Park, Burlington, MA 01803; 617-229-9797.**

Circle No. 321 on Inquiry Card

Gunning The DMA Engine

Yarc Systems' VME-based Vorpal board incorporates AMD's 29K RISC chip and a unique first-in, first-out DMA (direct memory access) chip, so that VMEbus transactions are off-loaded from the CPU. The CPU sends series of data transfer instructions into the DMA engine and continues with processing while the DMA engine performs the I/O in the background. You can write software for the board in C, Fortran, or Assembler using Yarc's debugging tools. The Vorpal board comes in speeds up to 33 MHz and with up to 4 megabytes of SRAM. Price for the Vorpal is $4,500, depending on configuration and options. **Yarc Systems, 27489 W. Agoura Rd., Agoura Hills, CA 91301; 818-889-4388.**

Circle No. 322 on Inquiry Card

Sometimes You Win, Sometimes You M-WIN

Matrox's M-WIN 1280 graphics board for AT-based 286 and 386 PCs and EISA-based 486 PCs helps you support X Windows applications in your PC. Using a combination of high-speed, off-screen memory BITBLTs, a 1280-by-1024 non-interlaced display, and Matrox-developed window drivers, the M-WIN 1280 displays up to 256 screen colors from a palette of 16.7 million and contains a 2K-by-1K frame buffer which provides on-board storage for fonts, icons, and cursor bitmaps.

Utilizing the Western Digital 8514/A chip set, the M-WIN 1280 runs all 8514/A-compatible software at 1024-by-768 resolution, while a special driver can switch resolution mode to 1280-by-1024. Because the driver supports 24-bit programs, you can run them without installing a 24-bit card. The board supports X via Interactive Systems and Hummingbird Communications' PC-based X Windows servers. Quantity-one price is $2,495.

Also available is the EG3-1280 graphics board, adding 24-bit/pixel frame buffer and 16-bit Z buffer capabilities on EISA-based 386 and 486 PCs. It offers X Windows compatibility, SCSI interface, and VGA pass-through capabilities. Quantity-one price is $7,995. **Matrox Electronic Systems, 1055 St. Regis Blvd., Dorval, PQ H9P 2T4; 514-685-2630.**

Circle No. 323 on Inquiry Card

SCSI Double Feature

Ardat's 3 1/2-inch digital audio tape (DAT) drive, the Python DDS DAT 4320, combines for the first time both SCSI I and II interfaces. It improves single-tape storage capacity, offering either two gigabytes per cassette or four gigabytes per cassette with on-board DCLZ data compression. Backward-compatible with Ardat's existing Python line DAT products, the 4320 has a data transfer rate of 183 kilobytes per second and an average file seek time of 20 seconds. Prices start at $1,500 in OEM quantities. **Ardat, 1650 Sunflower Ave., Costa Mesa, CA 92626; 800-327-8827 or 714-641-1230.**

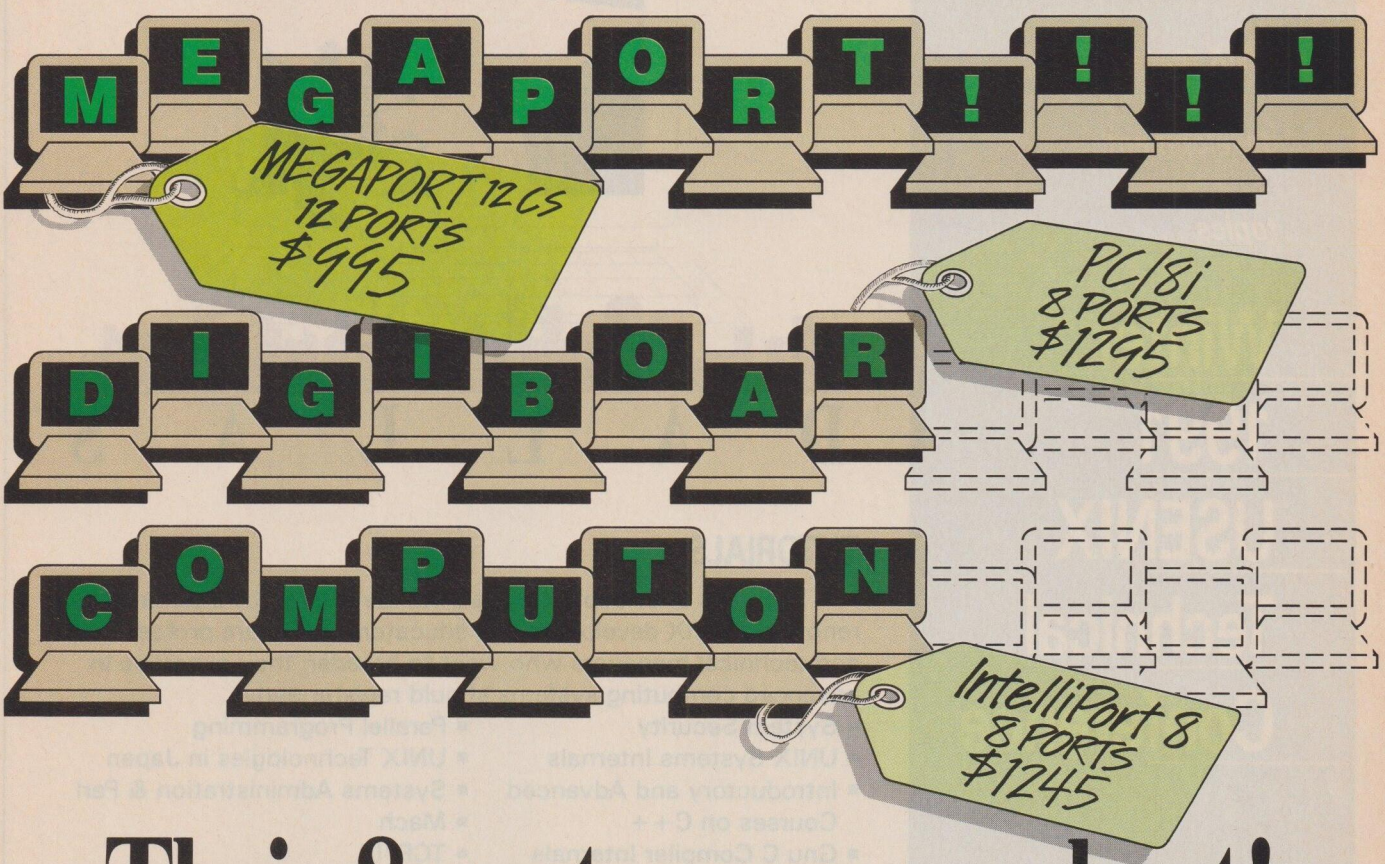
Circle No. 324 on Inquiry Card

Hardware and Software Support

To **Altos**: Western Automation's Acumen 5000 memory boards for addition of 8, 16, or 32 megabytes of RAM into the Series 5000, and Acumen 800 memory boards for addition of one megabyte RAM into the Altos 686 and 886 (800-227-4637 or 303-449-6400).

To **Apple A/UX 2.0**: DigiBoard's DigiChannel Nu/Xi multiport communications card (612-922-8055); to **Concurrent 6000 and 8000**: Mercury Computer Systems' VA2 vector processor module (201-758-7000); to **Data General Aviion**: its Model 5069 single-board VMEbus-based vector processor (508-898-4051); QTC's Math Advantage scientific and engineering mathematics library (800-234-0168 or 503-626-3081).

MEGAPORT MEGAVALUE *for Economy!*



Their 8 ports come up short!

It's true that ports are better by the dozen! MEGAPORT offers 12 ports for a lower cost than their 8-port boards; *and* our 24-port model is less expensive than their 16-port boards. Buying our 12- or 24-port board is like getting 50% more ports for free—giving your system room to grow at no additional cost!

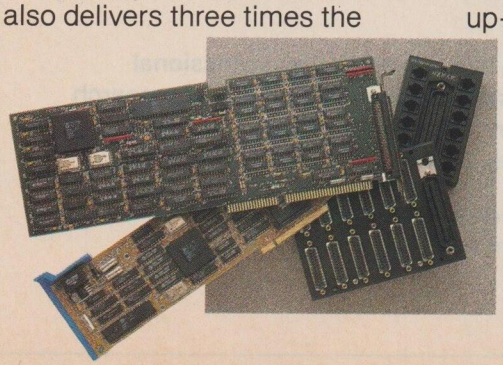
By comparison, MEGAPORT also delivers three times the performance. Competitive models suffer significant throughput degradation as system load increases. Our custom RISC-type chip set delivers 38.4 kbps throughput that *never* degrades—even with all ports active! That means a faster-running system, with snappy screen refreshes.

And MEGAPORT is the only serial I/O board with "soft" set-up—no dip switches, no straps and no programming of interrupts, I/O addresses or DMA channels.

Drivers are included at no extra cost for all the popular versions of System V UNIX, XENIX and IBM's AIX. They provide everything you demand from a premium multi-user board, including transparent print, multiple sessions, function-key remap and more.

MEGAPORT 12- and 24-port models feature a 3-year warranty and are available for AT, EISA and Micro Channel systems.

Don't fall short on ports, performance and value. Call Equinox today.



EQUINOX

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14260 S.W. 119 Avenue
Miami, FL 33186
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CIRCLE NO. 210 ON INQUIRY CARD

For the latest UNIX research & development topics . . .

Winter 1991 USENIX Technical Conference

Grand Kempinski Hotel

Dallas, Texas

January 21-25, 1991

TUTORIALS

Two days of in-depth tutorials will be offered by internationally renowned UNIX developers and educators. Software professionals and technical managers who want to broaden their expertise in advanced computing systems should register early!

- System Security
- UNIX Systems Internals
- Introductory and Advanced Courses on C++
- Gnu C Compiler Internals
- Graphics and X Windows
- Parallel Programming
- UNIX Technologies in Japan
- Systems Administration & Perl
- Mach
- TCP/IP
- Network Programming & Security

TECHNICAL SESSIONS

Presentations by leading experts on the evolution and development of the UNIX operating system will feature:

- Operating Systems of the Future
- Communications and Networking
- Applications
- User Interfaces
- Programming Environments and Languages
- Testing and Debugging

Special interest sessions offer the attendees an opportunity to exchange information and ideas on such topics as systems administration, security and networking. Facilities featuring Internet and dialout access for attendees is provided.

THE SPONSOR

The USENIX Association is a not-for-profit professional organization dedicated to fostering the development of research and technological information pertaining to UNIX and advanced computing systems.

The 1991 UniForum Trade Show will be held at the Dallas Infomart on the same dates as the USENIX Conference.

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The Professional and Technical UNIX Association

USENIX

For complete conference details, call:
(714) 588-8649 or write:
USENIX Conference Office
22672 Lambert St., Suite 613
El Toro, CA 92630

CIRCLE NO. 31 ON INQUIRY CARD

To **Hewlett-Packard**: Mt. Xinu's K-AShare Apple connectivity software (415-644-0146); to **IBM RS/6000**: Interleaf Technical Publishing Software (617-577-9800); Westmount's integrated CASE tools (206-882-5644); to **Intel i960**: AGE's Xoftware X Window server software (619-565-7373); Intel's DB960CADIC in-circuit debugging monitor with in-circuit emulation (408-765-8080); Logic Automation's SmartModels behavioral simulation models (503-690-6900).

To **Interactive 386/ix**: Eicon Technology's EiconScript printer controller board (514-631-2592); QTC's Math Advantage scientific and engineering mathematics library (800-234-0168 or 503-626-3081).

To **NCR System 3000**: Concept Omega's Thoroughbred Idol-IV 4GL (800-524-0430 or 908-560-1377); Interactive's VP/ix DOS-under-UNIX software (213-453-8649); Sybase's RDBMS (800-879-2273).

To **Next**: Adobe Systems' Adobe Illustrator (800-344-8335); HSD Microcomputer's Scan-X OCR software (415-964-1400); Insignia Solutions' SoftPC connectivity software (408-522-7600); Oracle's RDBMS (415-506-7000); RightBrain's TouchType typesetting software (415-851-1785); Sybase's SQL Server (800-879-2273); Transarc's AFS distributed file system (412-338-4400); WordPerfect word processing software (801-222-5300).

To **SCO UNIX**: AGE's Xoftware PC X server (619-565-7373); Eicon Technology's EiconScript printer controller board (514-631-2592).

To **Silicon Graphics** Iris 4D: Informix's OnLine OLTP multimedia database engine and Wingz spreadsheet (415-926-6300); Ingres' Intelligent DBMS (415-769-1400); Interbase 3.0 RDBMS (617-275-3222); Island Graphics' IslandWrite, IslandPaint, and Island Draw desktop publishing and personal productivity programs (415-491-1000); Quality Software Products' Exclaim spreadsheet and MasterPlan project management system (213-410-0303); Sybase's SQL Server, SQL Toolset and Open Client database connectivity software (800-879-2273); TEI's Vue project management system (415-525-7774); Versant Object Technology's object-oriented database management system (415-325-2300).

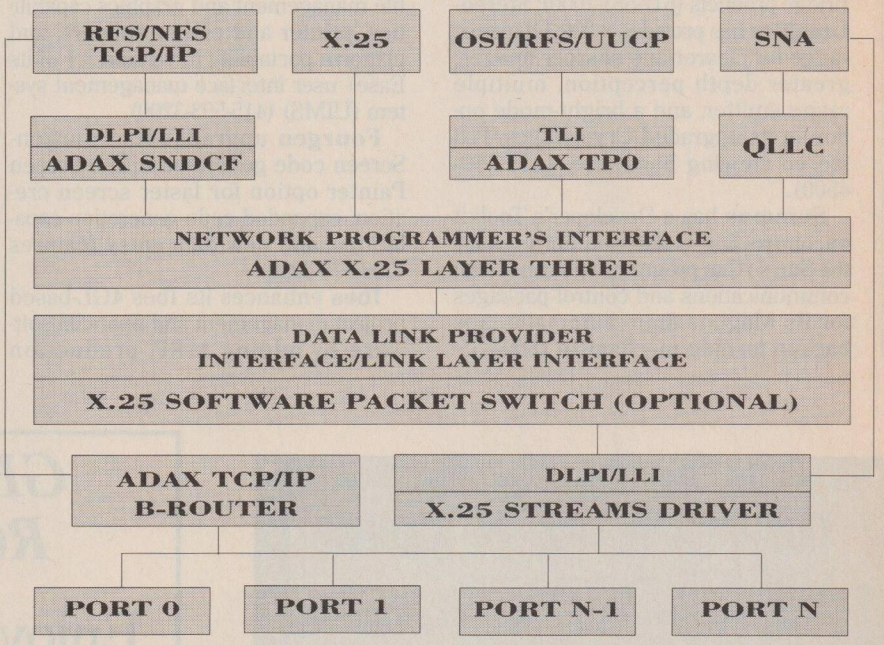
To **Sun's NewsPrint** PostScript-compatible printing software: printers and plotters from Canon, Epson, Fujitsu, Hewlett-Packard, Kodak, Xerox, Mitsubishi, Okidata, Raster Graphics, Seiko, Talaris, and Versatec (415-960-1300); to **Sun**: Information Dimensions' BasisPlus text information management system (614-761-8083); MicroWay's NDP Fortran, C, C++, and Pascal compilers (508-746-7341).

To **System V/386**: DigiBoard's AT bus-based multichannel communications boards (612-922-8055); Welcom Software Technology's Open Plan project management software (713-558-0514); WordPerfect 5.0 (801-222-5300).

Hardware Upgrades

Cisco Systems adds AppleTalk Phase II communication protocol support and

ADAX BUILDS WIDE-AREA NETWORKS



MULTIPLE PHYSICAL PORTS: 9.6K bps - 2.04M bps

ADAX hardware and software provide the most advanced wide-area communications solution on the market today. Based upon 1984 CCITT X.25 with AT&T streams-based modules, the network you build today will carry you seamlessly into the future. ADAX software supports all major TCP/IP vendors, as well as OSI over pure X.25 connections, or TCP/IP or TP4 datagrams. Custom integration is possible at all layers via ADAX's implementation of AT&T's standard interfaces. ADAX's host-resident X.25 Software Switch, which supports 2 to 128 ports, makes a highly efficient host gateway or optionally, a stand-alone packet switch. All of this can be done on a PC 386/486 platform.

ADAX's advanced series of protocol controllers (APC) are the only controllers on the market which provide 9.6K bps - 2.04M bps throughput with 99.9% efficiency on multiple physical ports simultaneously. Available on ATbus and VMEbus platforms today, an EISA bus version will be on the market by 1991. *For further information contact:*

ADAX, Inc.
630 Bancroft Way
Berkeley, CA 94710
USA
Telephone: 415/548-7047
FAX: 415/548-5526

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a new priority queueing feature to its routers (415-326-1941).

Interphase SoftArray runs on its VME-based host bus adapters, and lets you spread data across multiple drives, or make portions of separate drives work together as a single drive; you can also configure the software to activate striping, spanning or mirroring (214-919-9000).

Microcom adds T1 and X.25 compression capabilities and combined bridge/router features to its LAN Bridge products (617-551-1000); **Stereo-Graphics** has provided a 300:1 dynamic range for clearer and sharper images, greater depth perception, multiple range emitter, and a bright-mode option in its upgraded CrystalEyes/Pro stereo viewing hardware. (415-459-4500).

Summus has a Developer's Toolkit encompassing C function libraries for the Sun so that programmers can create communications and control packages for its Magnus 8mm automatic tape backup loading mechanism (800-255-9638 or 713-492-6611).

Wellfleet integrates management capability for Novell LANtern, Synoptics LattisNet, and multivendor routers into version 2.0 of its SNMP network management software (617-275-2400).

Software Upgrades

Delta Microsystems enhances its Budtool backup utility with automated file retrieval and a file history database (415-449-6881).

Expert-Ease Systems improves the file management and graphics capabilities, printer and plotter support, and platform portability in version 3.1 of its Ease+ user interface management system (UIMS) (415-593-3200).

Fourgen upgrades its Fourgen-Screen code generator with a Screen Painter option for faster screen creation, expanded code generation capabilities, and new data entry features (206-776-5088).

Ibes enhances its Ibes 4GL-based project management and financial software by adding MRP, production scheduling, capacity planning, and job-order tracking to its manufacturing modules; POS, warranty tracking, and requisitions to its distribution modules; and cash management and human resources to its financial modules (214-907-8475).

Imagine adds color support, CD-ROM support, and full-motion video recording, storage, and playback capabilities to its MediaStation multimedia software for the Next computer (313-487-7117); **JYACC** adds virtual screens, viewports, radio buttons, checklists, scroll bars, 8-bit internationalization, and screen-editing facilities to JAM (JYACC Application Manager) version 5 (212-267-7722).

SBT adds the Laser Forms print utility for outputting forms, invoices, and packing slips out of a laser printer to its Database Accounting Library (415-331-9900).

Six Sigma Case adds a database design history and the ability to write a data model in different formats to version 1.5 of its Canonizer database nor-

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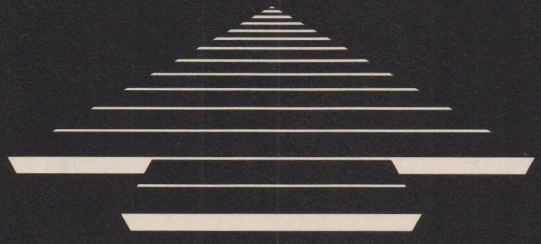

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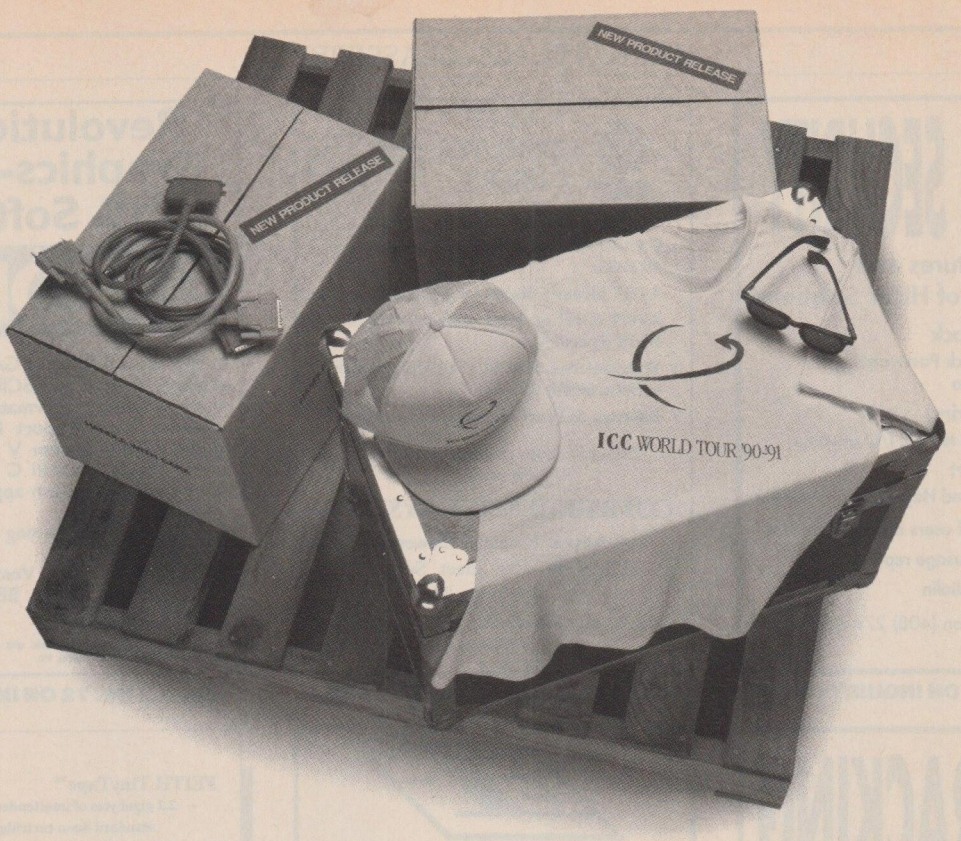

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A NEW WAY TO ANALYZE CONFLICTING SURVEY DATA

It can be difficult to make a decision based on the various results of many research studies, especially when the conclusions contradict each other. These contradictions generally aren't easy to reconcile. Usually no two studies use precisely the same methods or are made under exactly the same conditions. Hardly ever does any one of the studies contain enough cases to be conclusive.

Increasingly, a solution is being found in a computer-based technique called meta-analysis. Meta-analysis statistically sorts through differing studies to find a minimal common ground. Often this common ground is enough to bring out important facts that couldn't be validly derived from any one of the studies by itself.

Meta-analysis works because most studies today are complex. Complexity makes investigations that look different on the surface overlap in certain areas, because investigators try to answer many questions in just one study. Not all the overlapping is obvious. Much of it only becomes clear when Boolean analysis shows that certain factors in one study are logically equivalent to seemingly unrelated factors in another. The most frequent common ground is called the null hypothesis. It tests whether the course of action being tried is producing no effects at all.

The concepts that underlie meta-analysis originated in the work of a succession of Britain's knighted scientists. Meta-analysis' leading expert and advocate today is a young British mathematician at Oxford University, Richard Peto. He has neither knighthood nor a doctoral degree.

Despite its British origins, a lot of work on and with meta-analysis has been done around the world. It was named by Gene Glass of the University of Arizona.

Worldwide, meta-analysis is most often used to evaluate new pharmaceuticals and other medical treatments. The largest meta-analysis to date evaluated more than 3,000 clinical studies in perinatal medicine and obstetrics. It found that many standard practices are unnecessary or even harmful, and many neglected techniques should be used far more often. One of the most striking meta-analyses ever done made it evident that taking aspirin greatly reduces chances of heart attacks. This meta-analysis was done in 1980, well before a huge clinical trial demonstrated the same result.

In the United States, meta-analysis has frequently been used to examine research on social questions. A meta-analysis of 36 studies on releasing the mentally ill from institutions showed that they do equally well inside or outside institutional walls. Another project meta-analyzed 30 studies on the results of coaching students prior to taking the SAT (Scholastic Aptitude Test) for college admissions. It concluded that coaching gives only a tiny improvement in test scores.

Meta-analysis has been gaining supporters steadily over the past decade. They are still outnumbered, though, by determined, passionate critics. Objections to meta-analysis come in four varieties.

- It shares the unreliability of statistics. Meta-analysis is based on advanced statistical methods.
- Conclusions from meta-analysis may persuade researchers to discontinue direct studies before the final truth is discovered.
- Meta-analysis can be biased by the way studies are reported. Researchers commonly are quick to publish reports of studies that support the ideas people want to hear. Studies that produce unpleasant conclusions are often delayed or not reported at all. When a meta-analysis uses only the studies whose results were published, it must be biased toward popular conclusions.
- It replaces professional experts. Meta-analysis is designed to conclusively answer questions that previously had to be left to the professional judgement of experts in the field. No one likes to think that his or her hard-earned expertise could be superseded by a computer.

Supporters of meta-analysis agree that care is needed to be sure less popular study results are included, even when those studies were never published. They add that no firm conclusion from meta-analysis is known to have been disproved later by more of the same type of research that the meta-analysis reviewed.

As for potential human costs of superseded experts, meta-analysis supporters can only point to even larger human costs from ignorance of facts that meta-analysis could have provided. Decades ago the drug DES was given to prevent miscarriages, after extensive clinical trials seemed to have proved it safe. Eventually, experience showed that DES frequently caused cancer in daughters of women who took it. Recently, Iain Chalmers of Oxford University did a meta-analysis of the various clinical trial results available at the time that DES was being prescribed. His work showed the hazard so clearly that, had the meta-analysis been done at the time, DES almost certainly would never have been allowed on the market.

The theory behind meta-analysis is now well developed, and you can find textbooks in bookstores. One good introductory text is *Summing Up: The Science of Reviewing Research* by Richard Light and David Pillemer. Software packages for meta-analysis on UNIX systems are probably a year or more down the road.

ELECTRONIC WINDMILLS

Digital and analog electronics could provide a windmill with no moving parts. That is the object of a proposal by British science observer David Jones.

The heart of his device would be two huge metal mesh panels, an inch or so apart in the open air. One panel would be negatively charged and covered with sharp points. Both these features would cause this panel to emit electrons, which would convert some of the air being blown through to negative ions. Wind pressure forcing these ions against the mesh of the other panel would generate electrical power. A few square yards of panel area might generate a kilowatt or more in a strong breeze. Computer-controlled electronics would then convert the irregular generated power to a constant, usable line voltage.

This concept's advantages over conventional windmills go beyond eliminating moving parts and cutting costs. Electronic windpower wouldn't broadcast radio-frequency interference. There would be no need to disengage electronic windmills in high winds, just when the potential for power generation is greatest. They would improve the landscape esthetics by maintaining a comparatively low profile. And, because many of the negative ions are sure to be blown through the second mesh panel and escape into open air, people living downwind would receive the general health benefits attributed to negative ion generators, indoors and out.

—Compiled by Walter Zintz

continued from page 163

(SNA) technology and products; integrated services digital network (ISDN); and strategic and tactical planning for global telecommunications. Up to 400 exhibitors are scheduled to display their wares at the conference. It will be held at the Washington Convention Center, Washington, D.C. Contact Michael Sullivan, 508-820-8268.

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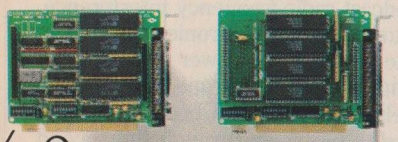
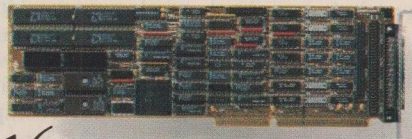


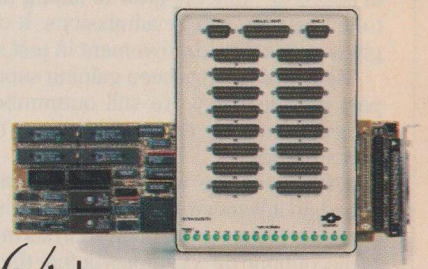
4-8

Our Hostess multiuser serial controllers are an excellent choice for up to eight occasional users. The Hostess 550 provides buffering for even higher performance. And for truly high performance, choose the Ultra 8.



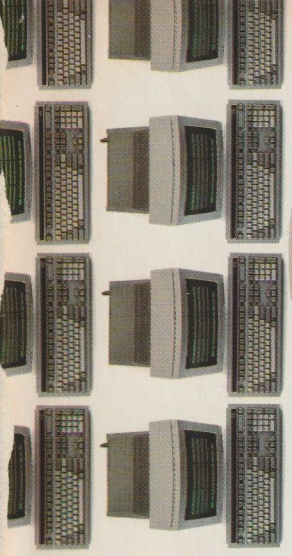
16

Expand up to 16 users with the Ultra 16 high performance intelligent serial controller. But if your multiuser requirements are more modest a 16 port Hostess 550 controller makes an equally intelligent choice.



64+

Our Ultra Cluster gives you the flexibility and power for virtually limitless growth. Starting with an Ultra 8 base board, you can expand 16 users at a time, while maintaining current levels of performance every step of the way.

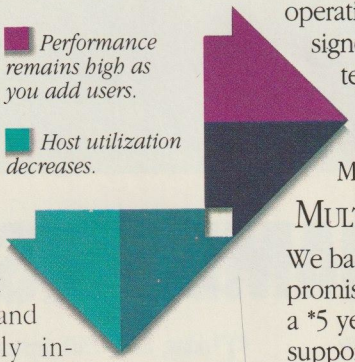


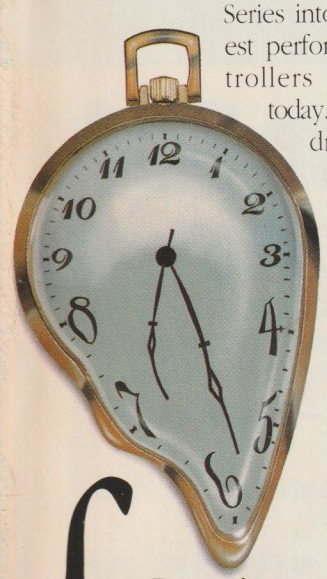
Multiply Your Choices

At Comtrol we pioneered multiuser technology. And we know that there are no single solutions to multiuser environments. That's why we offer more choices than any other company...from text to graphics...for modest users to over 64 users supported by a single PC. And we've not only multiplied your choices, we've multiplied performance, allowing you to expand without the high cost of adding computers.

Multiplied Performance

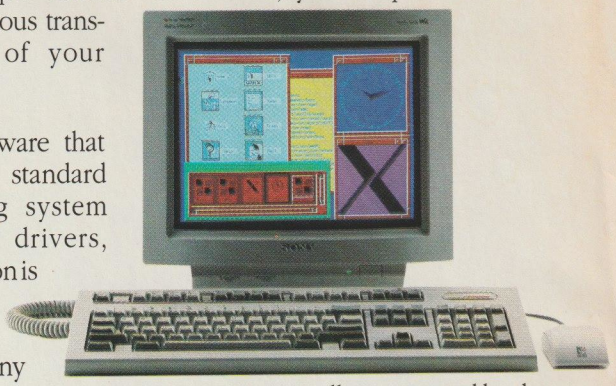
No company offers you more performance than Comtrol. In fact, our new DT *Express* driver transforms our Ultra Series into the highest performing controllers available today. DT *Express* dramatically reduces host utilization and significantly increases throughput by managing all data transmission and data transform functions on the controller. So now as you add users, no one gets caught in a wait state.





MultiVision. For Choices Beyond Words

When graphics enter the equation, MultiVision enters the picture. A fully functional multiuser system for up to 16 users, MultiVision speeds images to the screen at a blistering 100 megabits per second. As a result, you'll experience near instantaneous transmission of your graphics.



With software that enhances standard operating system graphics drivers, MultiVision is compatible with virtually any monitor, keyboard, mouse or VGA controller supported by the operating system. MultiVision can also run applications designed for the "X" environment. But unlike a LAN-based "X" terminal, MultiVision is a multiuser system that transfers data up to 100 times faster. When you compare that performance with the cost of an "X" terminal... MultiVision's advantages really compute.

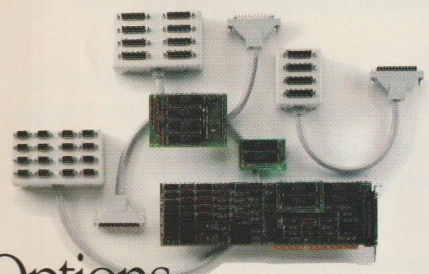
Multiplied Protection

We back our products with an uncompromising 30-day satisfaction guarantee, a *5 year warranty, complete technical support, and most importantly...a company that's easy to do business with. It all adds up to the best protection plan available. And if you're a VAR, call us about our Reseller Program that provides you with options designed exclusively for your needs. **1 yr. MultiVision*

30/5

See us at
COMDEX/Fall '90
November 12-16, 1990
In Bally's Booth B540
Las Vegas, Nevada

for Multi-Users.



Options

Our products offer serial port and memory options that are field upgradable; compatibility with ISA (AT), MicroChannel and EISA buses; RS232, 422, 485 and Current Loop interfaces and DB 9, DB 25 and RJ 45 connectors.

Graphics

When your needs move beyond text, MultiVision moves into view--a high speed (100 megabits per second) communications controller that offers near instantaneous multiuser graphics like you've never seen before.

Comtrol
A Control Systems Company
Multiply your choices. Call Comtrol today.
1-800-926-6876
Comtrol Corp., 2675 Patton Road, P.O. Box 64750 St. Paul, MN 55164

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CIRCLE NO. 149 ON INQUIRY CARD

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Not too long ago, a few dozen people sharing the same programs, resources, and information on a single computer at the same time meant only one thing—a mainframe.

Powerful, big, expensive, and proprietary.

More recently, the same people could be found doing exactly the same things—simultaneously sharing programs, resources, and information—on a minicomputer.

A lot cheaper, a lot smaller, yet powerful enough to do the same jobs. And just as proprietary.

Then along came the latest generation of advanced personal computers. And now, the same people are more and more likely to be found doing exactly the same things—simultaneously sharing programs, resources, and information—on a PC.

And not a whole officeful of PCs networked together, either, but *a single PC powering the whole office at once.*

A *lot* cheaper, a *lot* smaller, yet still easily powerful enough to do the same jobs. Built to non-proprietary, open system standards that allow complete freedom of choice in hardware and software.

And running the industry-choice multiuser, multitasking UNIX® System V platform that gives millions of 286- and 386-based PC users mainframe power every business day.

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Today, SCO UNIX System solutions are installed on more than one in ten of all leading 386 computers in operation worldwide.

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Running multiuser PC communications to minis and mainframes through TCP/IP and SNA networks.

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